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CORPULENCE;

OR,

EXCESS OF FAT IN THE HUMAN BODY:

ITS RELATIONS TO

CHEMISTRY AND PHYSIOLOGY,

ITS BEARINGS ON OTHER DISEASES AND THE VALUE OF HUMAN
LIFE, AND ITS INDICATIONS OF TREATMENT.

WITH AN APPENDIX
ON
EMACIATION.

BY

THOMAS KING CHAMBERS, D.M.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, AND GULSTONIAN
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TO THE READER.

The substance of this little treatise was contained

ERRATA.

Page 61, line 15, for "seventeen," read "eight."
„ 70, „ 1, „ "height," read "weight."
„ 76, „ 14, „ "5 stones," read "6 stones."

professional auditory to even an inexperienced speaker. I am told that my choice was a fortunate one, and have been requested by many friends who did, and many who did not hear me, to give them an opportunity of criticizing what I said, more at their ease than the rather incommodious benches of our College Theatre allow. The manuscript notes were sent to the "Lancet," and I intended from the type put up by the printers of that periodical to have had copies struck off for those who paid me the kind compliment of asking for them. But, through some misunderstanding, of which I threw the blame on the printer, and the printer on me, the type was broken up immediately after it had been used for the journal. I was thus disappointed in my plan. This good effect, however, has resulted, that I looked over again what I had written, and in reprinting it am enabled to fulfil my engagements with interest, by presenting a somewhat less faulty composition than was actually delivered. The asperities and errors of that arose partly from too little opportunity being afforded for correction; the deficiencies which remain are irremediable, they are to be attributed to the author's want of power, and not to the want of time given to make the offering a worthy one.

T. K. C.

1, HILL STREET, BERKELEY SQUARE,
August 1850.

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CHAPTER I.

Literature of the subject scanty. Obesity distinguished from fatty degeneration. Molecular and vesicular fat. Anatomical characters of fat-vesicles; their form; the impermeability to their contents; their capillaries; their nuclei and development. Mechanical uses of fat as a constituent of the animal body. Chemical use of fat as a store of carbon for the respiration under certain circumstances. Opinions of the early Greek philosophers on this head. Fat as an excretion and secretion. Consequences of its retention in the blood. Aptitude of fat for its functions as derived from its chemical and physiological properties.

The exaggeration of those vital functions which cause the deposition of fat in its proper tissue, is in itself an actual disease, and a very common one; and their insufficiency is a sign of most derangements of our frame: the former state affecting at least one in twenty of our patients, and the latter two-thirds of the remainder. They have, however, received but little separate notice from practical writers in our profession. True they are but symptoms of various internal changes, but so is almost every other disorder for which a physician is consulted: fever, dropsy, delirium, have not, from being merely symptoms, missed their meed of attention.

I cannot help thinking that people have been deterred, by a certain air of ridicule which appears to have become attached by some means to the subject, from attributing to it the importance it really deserves. An indication of this may be seen in the work to which appears conceded the rank of being the classical one on the subject, "Wadd's Commentaries on Corpulency and Lineaments of Leanness." The very title of the book, like a human face, shows the bias of the mind within; and is so far a good title, that we are not deceived in our expectation of finding the author make a free use of those dangerous gifts to a member of our profession, wit and humour. With the exception of Encyclopædic writers, who are obliged to touch on the subject in alphabetical order, no one has taken it up since his time; so that, in the present day, to expect to throw some new light on it is not to set up a claim to originality.

But Mr. Wadd is not the only one who has treated this subject with what appears to me most ill-judged levity; it seems to have been viewed by all as more a matter of curiosity than of true practical importance, and cases collected rather to furnish amusement than to increase knowledge. We read in the Philosophical Transactions of horses' backs broken by corpulent individuals, of walls pulled down to allow exit to their coffins, of the number of men that carried them to the tomb, and such-like puerile details; but scarce a word of circumstances which, as physiologists or practitioners, we would wish to know. All description of the individuals, of their habits, their diseases, the causes of their death, is omitted; and even the stature, by which alone can obesity be judged of, is not recorded. I confess I cannot understand how any human infirmity which involves pain and discomfort can ever be a fit object of ridicule, or how that which certainly shortens the term of life can be considered of trivial importance. I shall not be deterred by these precedents from making CORPULENCE or Obesity a matter of serious attention.

Obesity, or Polysarcia, as it is called by systematic writers, must be viewed as a true hypertrophy of the *tela adiposa*—an increased growth, without change in chemical or anatomical characters. I am the more anxious to give this definition, in order to draw a strong line of demarcation between such a state and that degeneration of muscle and other tissues into fat, to which the labours of Professor Rokitansky have latterly drawn such deserved attention. He designates this degeneration as a *false* hypertrophy. "False hypertrophies," he observes, "are recognisable, at the first glance, by the alienation of the whole habit of the organ. . . . . They appear as fatty disease of the liver, as albuminous, lardaceous infiltration of the same, of the spleen, of the kidneys . . . . as a change of the muscular fibrils into *molecular* fat, with destruction of the transverse striæ, and irregular distension of their sheath."* What he calls false hypertrophy is better classed by Mr. Paget as an atrophy; for in it, while the organ is altered in shape, and sometimes also in size, the interstitial nourishment of its tissue by the substance proper to it is certainly diminished. Indeed, this last state is so entirely different from an increased accumulation of fat, that the two may be pathologically contrasted,—in *that* the substance of some necessary part of the body is removed, and replaced by a matter foreign to it; but in obesity the tissues of all the members remain intact, possess all the parts requisite to execute their offices, and are only impeded in the performance of them when the additional superimposed matter alters the shape so far as to offer a mechanical obstacle to free action.

I should not have spent so many words on this question did I not view it as one of great practical importance, bearing not merely on the abstract classification of disease, but on that classification which we adopt in our own minds when we treat the individual patient affected. I am sure that where a confusion exists in the mind of the practitioner between true Hypertrophy, or the overgrowth of a natural tissue, and that growth which consists in the development of a substance improper to the situation where it is found,—I am sure that where this confusion exists, great mistakes must be made in the treatment.

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* Handbuch der path. Anat., Bd. i. S. 72, 289.

Now, the fatty matter developed in the conditions which I am labouring to contrast with clearness, affords in its very form, as well as in the circumstances of its growth, a difference in the two cases which may rationally be made the ground-work of a pathological distinction. In the true hypertrophy of fat deposited in excess, it is contained, like healthy fat, in distinct vesicles; while, in the other state, it appears under the microscope as loose molecules interspersed in greater or less abundance in the degenerated tissue.

To distinguish shortly the two kinds of fat, we will call the one found in false hypertrophy *molecular*, and the natural form, to which our attention will be directed, *vesicular* fat.

Now, where a pathological state depends on the presence of a tissue altogether improper, or improper to the place it occupies, the limits of health and disease are clearly enough defined by the eye, the microscope, or chemical analysis; but where it depends on the over-development of a normal condition, it is very difficult to draw the boundary line.

Physiology is more intimately connected with morbid anatomy in this case than in the discussion of other diseases.

A review, therefore, of our knowledge of the physiology of fat, will be a necessary prelude to our reflections on its morbid excess or deficiency; and I shall not hesitate to spend a considerable portion of the space allotted me, in drawing attention to the phænomena of the healthy growth of adipose tissue, before I come to consider it as a disease.

Natural fat, viewed *anatomically* as a simple substance, is in vertebrate animals* deposited, not in homogeneous masses, but, as above stated, in vesicles specially provided for its reception. Each vesicle is a perfect organ in itself, has a distinct wall, and is supplied on its exterior by capillary blood-vessels. The perfect envelopment of the whole fat by this membrane is shown by the experiment of floating a piece of fat in water, and raising the temperature to 104° Fahrenheit, when the fat will not escape, though perfectly fluid. Its form may also be seen by placing a piece of lacerated fat on a sieve, and directing a stream of water upon it; the fat may be washed out as a fine dust, the particles of which will remain distinct, may be skimmed off the surface of the water, and dried without uniting. Their shape is round or oblong, but from compression they assume the polyhedral form which Leeuwenhoeck* has attributed to them in his engraving.

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* I am informed by Dr. Thos. Williams, of Swansea, that in insects fat is naturally deposited without being inclosed in vesicles.

Mr. Paget† has pointed out an interesting peculiarity of the fat-vesicles—namely, that their contents, though fluid, do not pass by exosmosis through the membranous walls. This he ingeniously explains, by noticing that the membrane is moistened continually by the same fluid which all tissues imbibe from the blood-vessels—that is, water containing albumen and salts in solution. With this the oil has no disposition to mix, and thus each drop is imprisoned in a vesicle of impermeable tissue. During life, the oil-cells, by the attraction of their walls, constantly imbibe this watery fluid from the capillary vessels that surround them; and after death, if fat be kept in or near water, no oil transudes till the cells decompose. They retain their contents on the same principle that an oil-silk bag holds water: the one is rendered waterproof by oil, and the other oil-proof by water. The fluid thus inclosed in an impermeable sac, being incompressible, is highly elastic, and diffuses pressure equally in all directions. It is similar, in fact, in its construction to a water-pillow; and is similar in its use too, for, distributed about the sole of the foot and the nates, it enables us to stand or sit with easy comfort, without the fear of squeezing out the oil from the tissue.

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* Philosophical Transactions, Sept. 1674, and Aug. 1722.

† Medical Gazette, January 24th, 1840.

The membrane is supplied with this necessary watery fluid by the capillary blood-vessels, which ramify in great abundance among the vesicles, forming loops around each, and detaining the blood as long as possible in their vicinity. When the vesicles increase in number, these blood-vessels increase in number also, and appear capable of almost indefinite multiplication. How great must be the effect of this upon the circulation! If, for instance, a man of five feet two inches, whose healthy weight would be eight stones, increases to twenty-eight, no less than twenty stones of additional fat have to be supplied with capillaries, and those capillaries have to be supplied with blood by vessels constructed to circulate but one-third of the quantity. How wonderful must be the power of adaptation which can render such a change consistent with life at all! how little cause for surprise if that life is short, and burthened with innumerable ills!

There is some doubt whether the adipose vesicle retains in its perfect state the nucleus of its early development. In places where fat is imperfectly formed—as, for example, in the scrotum—vesicles may be usually found containing nuclei; but in the healthy *panniculus adiposus* or the mesentery of the adult, they cannot be detected, even by squeezing out the fat and examining the empty membrane. It is possible that, when full of fat, the vesicle may contain a nucleus, hidden by the highly refractive semi-fluid secretion; or that it may be destroyed by the violent process of compression. And this view receives confirmation from the fact, that in emaciated subjects, and those affected by chronic anasarca, a nucleiform body may be found in many vesicles.* The same appearance, also, is observed in fatty tumors, which are an instance of true hypertrophy of adipose tissue, from some unknown cause confined to one spot. In them the nucleated vesicles may be seen mixed up with others non-nucleated, and filled in various degrees with their secretion. Yet these tumors are active and growing, and we can hardly suppose that any of their vesicles are effete or emaciated. In this condition the enveloping membrane is distended with water, and the fat floats in a yellow globule in the centre, leaving a free space between itself and the wall, and enabling us to examine the latter more accurately.

This question will become of more importance when we are better acquainted with the signification and action of the permanent nuclei in a tissue, and whether they denote merely its imperfection or its destination for further duties. Whether nucleated or not, the fat-vesicle is obviously a component part of the body; and though the oil-globules contained in them may be viewed, in a certain sense, as an excretion, the sac which holds them is as necessary to the idea of an animal as muscles, bones, or tendons. The oft-quoted *dictum* of John Hunter, that "fat is no part of an animal," is spoken in the character of a chemist merely, and must not be robbed of the truth it contains by being wrongly applied, or understood too literally.

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* Kölliker, in Siebold and Kölliker's "Zeitschrift für wissenschaftlichen Zoologie," 1850.

As a constituent of the bodily frame, fat has important duties to perform. It fills up those angular spaces which the mechanical form of parts most convenient for motion leaves between them. Thus it acts as a pad on which the eye may revolve with fluency. The form of the heart, if it consisted of its muscular structure only, unfits it for moving freely in a confined space, and the periodical alterations in shape would cause a most inconvenient amount of friction. It is, therefore, padded into a smooth rounded form by adipose tissue. The same purpose appears to be answered by the omentum and the mesentery, by the fat-vesicles in the Haversian canals of bone, and in the spinal canal, in the interspaces of the joints, in the muscles of the palm, &c.

Fat answers, also, the purpose of retaining warmth, and so enabling the body to be less exhausted by its exertions in the production of heat. Therefore are the natives of cold regions more thickly clothed with this defence, and, by the quantity of it they possess, attract man's cupidity to the frozen Poles. So in winter, the hibernating animal, unable to keep up his heat by a continuous supply of food, is guarded against the destructive effect of cold by fat, and presents the anomaly noticed by the Roman poet, — of being in best condition when he has nothing to live upon but sleep:

> Tota mihi dormitur hiems, et pinguior illo
> Tempore sum, quo me nil nisi somnus alit,

says Martial's dormouse.* It is remarked by Professor Barkow, that creatures whose external covering protects them from cold during hibernation, lose much less weight when exposed to the air than those whose skin is more transpirable. Thus, a snail, weighing on the 6th of January eighty-five grains, on the 2d and 20th of February had undergone no appreciable change, and on the 8th of March weighed eighty-four grains and a half.

But a toad, on being dug up, lost three grains in a quarter of an hour.

A similar observation on a hedgehog showed a loss of nearly three ounces between the 19th of January and the 26th of April.* To prevent this loss, the toad buries himself deep in the ground; and the hedgehog and the dormouse, which cannot retreat so far from the frost, are very thickly covered with fat, some of which they can afford to lose without destruction.

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* Martialis Epigr. xiii. 15.

Besides these mechanical duties of facilitating motion, and acting as an external defence from the cold, fat appears in many cases to perform the chemical office of supplying fuel to the respiration, and so in another way contributes to keep up the animal heat. It serves, in fact, as a store-house of carbon for the use of the lungs. When cut off from the supply of food, an animal would soon be consumed by the hungry flame of vital heat, were there not something to burn besides his own person. Fat affords, in this case, a power of resistance to the overpowering continuous force of one of the functions of life. Thus the tadpole, from the fourteenth day after its exit from the egg, to the time of the alteration of its respiratory organs at the period of becoming a frog, contains daily more and more fat in the abdomen; but immediately after this change all the fat rapidly disappears.† The animal would probably, without this fat, be unable to bear the strain upon the constitution which the loss of the tail must occasion; but, by possessing such a reserve, can resist the new influences to which its body has not yet become habituated.

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* Barkow, Ueber Winterschlaf nach seinen Erscheinungen im Thierreich dargestellt. Berlin, 1846.

† Philosophical Transactions, vol. xlviii. p. 301.

Similar stores of fat are accumulated in the bodies of the Herbivora, while animals which feed upon flesh are spare and lean. The food of the horse is deficient in carbon compounds capable of absorption into his system: he can extract but little from it, however much and often he eats. If he was debarred for a short time from his pasture, the respiration must be supplied with fuel from his own substance. Fat, therefore, clothes his organs, and shields them from the consuming fire of respiratory absorption. But the lion and the boa take in so much carbon in a state of combination at one meal, that the accumulation of it in the blood suffices to prevent for a long time the combustion of the muscular fibre. They have, therefore, no occasion for reserves of fat, and exhibit that proportionate leanness which suits so well their active predatory habits.

This method adopted by Nature, of providing against the effects of a new chemical action in altered circumstances of the body by means of saving up a quantity of fat for the occasion, we may also see exemplified in our own race. For the first three days at least after birth, the human infant, in spite of the addition made to its substance by food, loses in weight to a considerable extent; consuming, in fact, by the novel function of respiration, matters previously unacted upon by oxygen.* It is not till the fifth or sixth day that it has got sufficiently used to its new life to assimilate enough to begin growing upon.†

Were a treasure of fat not provided against this contingency, injury to the tissues, and probably death, would follow.

It was such facts as these that induced the older Greek philosopers to conjecture that the intention of fat is to sustain the animal heat by combustion, "in the same way as oil supplies the flame of a lamp, and when that flame is less powerful, less required, that the fat is laid by as in a treasure-house."‡ I designedly translate from Galen, who is quoting the words of an ancient philosopher of the physical or præ-Socratic school for the purpose of ridiculing them, that I may have an opportunity of pointing out how early Greek philosophy was in the right path of theory, and how, probably, if it had continued in that path, it would have anticipated modern discovery. But the influence of the school of Socrates, followed up by his talented pupils, Aristotle and Plato, had diverted it to other subjects than the contemplation of Nature, and the consequences are here apparent. Here we see Galen, 400 years after Socrates, still led away by the verbal distinctions of his dialectic philosophy, and find him citing, only to dissent from, an opinion due to the school of Democritus, which later times have made their own, and our generation only at length proved.*

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* Does not this interesting fact explain in some degree that change of feature which all must have noticed during the first week of existence?—that change, I mean, which often enables us to observe a likeness to one or the other parent in the new-born, which likeness, when we see it the next day, has vanished.

† Professor Hofmann, of Munich, in the "Neue Zeitschrift für Geburtskunde." Berlin, 1849.

‡ Τοῦτον (τὸ λιπαρὸν) μὲν ἐν ταῖς τροφαῖς περιέχεσθαι, καταναλίσκεσθαι δὲ ὑπὸ τῆς ἐν ἡμῖν θερμασίας, ὥσπερ τοὔλαιον ὑπὸ τῆς φλογὸς, ἧς ἀῤῥώστου γινομένης, ἀθροίζεσθαι κατὰ τὸ σῶμα.—Galeni de Simpl. Medicam. Facult ii. 20.

It has been well remarked that all the tissues of the animal body are in a certain sense excretions; the materials which they abstract from the blood would, if not removed from it, prove injurious. They are, therefore, in relation to the animal economy, excretions. If the substance of the hair, bones, or skin, remained in the blood instead of being eliminated, it would be a foreign matter and a disease. In that sense may fat be called an excretion, and its removal from the circulating fluid no doubt desirable. At the same time the circumstances under which it is found there in excess are so various, that it is difficult to assign any one symptom or state to this cause. Thus it is exceedingly common in albuminuria, where it almost always makes the serum milky,* and sometimes is retained in such excess as to form a thick coat of

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* It is difficult to exaggerate the sad influence which the fatal talents of Socrates and his pupils exerted over the Greek mind. They turned the attention of their countrymen, and through them of the whole civilised world, to metaphysical speculation; to advance which branch of intellectual culture there is scarce a man in a century who is capable; whereas physical science can be promoted in various degrees by men of much inferior capacity. Aristophanes saw the evil in the bud, and pointed it out in his pantomime of "The Clouds;" but the attraction of apparent knowledge is too great for satire to counteract, and so men were diverted from the experimental school of Democritus—from a task in which all

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could have assisted—to one in which all were obliged to follow as imitators,

> "And dance, like fairies, a fantastic round,
> But neither change their motion or their ground."

There is in the present day a fear expressed lest the introduction of physical studies into our universities should render the English mind too empirical. Let us remember that, if this is an evil, there is an evil also of an opposite character, which checked the advance of intellect for 2000 years.

* Milky serum however, it may be observed in passing, does not always depend entirely on globular fat. The opaque matter sometimes is not soluble in ether, and has a form under the microscope different from oil. Rokitansky suggests that it may in such cases be a form of fibrin.

grease on the top of the blood drawn. It is found in jaundice* and pneumonia, where the organs affected being those immediately concerned with the oxidation of the carbon of the system, in some degree perhaps hint at some connection between their office and the phænomenon in question. But it is observed also in tuberculosis, in diabetes mellitus,† and even in temporary gastric derangements, in peritonitis, and habitual drunkards.‡ It is difficult to find any connection between these cases except general derangement of the circulating fluid, nor does the fat occasion any symptom in cases where it is observed, different from similar ones where it is not found. Yet, as it is not consistent with a state of absolute health, it is important that it should leave the blood as soon as possible.

It is clear, from what was said before about the cell-membrane of the vesicles, that fat cannot be formed by a mere exudation from the blood-vessels; it must originate in a vital process of secretion, which acts in spite of the physical principle opposing the transudation of oil. The activity with which it is separated will, therefore, as in the case of other secretions, depend on the general vital activity of the system. It will be quickly made when the constitution is vigorous, and quickly carried away; and its detention in the blood will coincide with sluggish action of the vital powers.

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* Mr. Simon (Lancet, June 22, 1850) quotes a case from Trail of jaundice, in which the serum contained 45 per 1000 of oily matter.

† Hoffmann's Grundlinien der phys. Chemie, S. 202; and Rokitansky, Path. Anatomie, Bd. i. S. 515.

‡ By Lecanu. Quoted also by Mr. Simon, as above.

Accordingly, in a state of health it would appear that the fat should very rapidly leave the circulating fluid: whatever be the nature of the food given to an animal, whether it be such as contains much oily matter, or is poor in such elements, the quantity found in the blood is not affected. Even entire deprivation of aliment does not entirely remove it where it should naturally exist, and feeding on pure grease does not increase it. M. Boussingault found exactly the same amount of oily matter in the blood of pigeons and ducks kept without food for some days, as in those which had been stuffed with lard.*

We can hardly fail to admire the peculiar aptitude for the duties assigned to it, which is displayed in the chemical and physical properties of fat. In the first place, its insolubility in water prevents it from transuding through the walls of the containing cells, and so being dissipated through the skin. The same insolubility prevents it also, when in the blood, from being carried off by the kidneys; and enables it to be retained as a treasure of fuel to the animal economy. The great amount of carbon and hydrogen which enter into its composition makes it exceedingly useful, as an excretion, in removing from the blood these elements. And the same carbon and hydrogen fit it peculiarly for supporting combustion, by union with the oxygen of the air, when it is required by the wants of the system. But yet, though capable of oxydization by conversion into carbonic acid and water, it does not so readily undergo that change by organic fermentation as some other organic compounds usually present in the body,—not so readily, for instance, as the starch and sugar introduced to the blood by the food, in which the oxygen and hydrogen are present in the proportions requisite to form water, and in which, therefore, the decomposition is simpler. This relative inferiority of oxydizing tendency fits it for being a store in reserve, which will not be used so long as other materials are present.

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* Annales de Chimie et de Phys., vol. xxiv. p. 460.

The union of the several forms of oily acids with the same base is another advantage, in that it causes them to be acted on by similar reagents, and therefore renders their mixture in different proportions, to form hard and soft fat, more permanent and convenient.

The close relation which its forms bear to one another, and their easy conversion by the loss or gain of certain quantities of oxygen, is an interesting point. Thus elain may be converted into stearin by the formation of water and carbonic acid,* according to chemical theory. And we have an instance in nature in the case of carnivorous animals, whose fat consists principally of margarin, gaining that fat by feeding on the bodies of grazing animals, in whom stearin and no margarin is found. On the other hand, the ox takes the margarin of the oil-cake and converts it into suet or stearin.

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* Beetz, Ann. der Chemie, p. 232, 1843.

CHAPTER II.

Origin of the fat. Partly found in the food. Partly formed from other alimentary principles by the chemical action of the secretions of the body. Improbably derived from the other tissues. Accidental causes of fat. The several circumstances under which it forms referable to one simple law.

HAVING reviewed what we know on the form and most prominent uses of fat, we are naturally led to reflect on its origin,—to trace how and whence it comes to form part of the animal body. The answer is immediately ready—It is taken with the food. But how? does it exist there, or can we make it, or is it all formed from the food? is any of it traceable to the transformation of other portions of the body?

The subject, then, divides itself into these three questions:—

Is it taken ready-made in the food?

Is it formed from other alimentary principles?

Is it formed by the decomposition of other tissues of the body?

First. Is it taken ready-made in the food?

It is a notion which suits well the dignified rank in creation which we usually assign to animals, to represent them as spared the laborious task of preparing the substance of their bodies, and as finding all the materials ready-formed in vegetables. The higher form of life which is given to the sensitive part of God's work seems to fit it to be the architect and master-builder of the forms for which the humbler plant supplies the material. The idea is said to have been first enunciated by Beccaria, of Bologna, in the year 1742.* At least, it is certain that he points out the strong resemblance which the gluten of wheat bears to muscular fibre, and the similarity of its mode of putrefaction to that of the animal matters in the urine. And then he adds, "Is it not true that we are formed of the same matters which serve as our nourishment?"

This opinion received very strong evidence in its favour from the discovery of substances identical with the tissues of the body in all articles of aliment. Vegetable fibrin, albumen, and gluten, were discovered. Fat or oil was long known to exist in small quantities in a great many of the articles of food—perhaps in all; and when the analyses of MM. Dumas, Boussingault, and Payen, ascertained that these quantities were not mere traces, but made a considerable fraction of the whole bulk, the conclusion was immediately formed, that all the fat of the animal body was derived from this source. The large proportion discovered by these chemists in all those vegetables which have been found the most rapid fatteners of stock of different sorts, afforded a ready explanation of their economical value.

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* Histoire de l'Académie de Bologna, Collect. Acad. xiv. 1. Quoted by Dr. Thomson, of Glasgow, On the Food of Animals, p. 158.

Thus maize, which is used to fatten the ancient Roman* luxury of the large-livered goose, at Strasburg, was found to contain, in 100 parts, 8·75; bran, so useful to the feeder of swine, 4·65; oat-straw, much used by graziers, 5·1. Artificial diets, constructed in imitation of these natural fatteners, are also found admirably suited to the same purpose. Poultry are fed, in some parts of the country, on a mixture of bran and suet, and amply repay the expense of their food by rapidly attaining perfection. The oil-cake, of which we hear so much from our farming friends, bears a price almost exactly proportionate to the quantity of oil it contains.

A similar deduction may be made from the experiments of Dr. Stark, who, in 1770, at the instigation of Sir John Pringle, performed a series of most zealous and self-denying experiments on his own person. He used to weigh himself while living on different articles of food for long periods, in order to ascertain their dietetic value. He found that a less quantity of suet was required to make up for the waste of his body than of any other sort of ordinary food, and that its power in this respect was to the lean parts of meat as three to one. Such, at least, is the inference to be drawn from the MS. account of his experiments left behind him after his melancholy end. In them we find that to keep up the weight of his body it was necessary to add but four ounces of suet to his allowance of bread, whereas a pound of lean beef was required for the same purpose.*

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* Martial. Epig. xiii. 58:

> "Adspice quam tumeat magno jecur ansere majus!
> Miratus dices, hoc, rogo, crevit ubi?"

It is curious to find the custom of eating the diseased viscus of a tortured animal so long survive the influences of a pure religion and rational civilization.

It is hardly possible to doubt that in these cases the fat is taken ready-made into the system, and deposited with but little change in the adipose vesicles. This view is certainly a very simple one; and, if it is the whole truth, the quantity of fat fixed or secreted by an animal will be represented almost exactly by the substances soluble in ether and alcohol, but insoluble in water, which makes a part of the forage consumed.

But, on the other hand, the formation has been described by Dr. Liebig as a modification of those principles of ternary composition which enter usually in a large proportion into the nourishment of herbivorous animals.

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* Dr. William Stark's Works, p. 141, Exp. xvii. and xviii.

Starch, sugar, gum, sugar of milk, may, on this hypothesis, be changed into fatty bodies, by losing, under the influence of the vital force, a part of their oxygen.

Dr. Liebig, then, we see, answers in the affirmative our second question, as to whether fat may be formed from other elements of the food besides the oleaginous.

The researches of chemists in their laboratories have done much to strengthen this last view. Under the influence of putrefying cheese, sugar undergoes a kind of fermentation, which results in the formation of butyric acid. Valerianic acid, which M. Chevreul discovered first in porpoise-blubber, is found to be also formed during the decomposition of beet-root, potatoes, and wheat. In the fermentation of sugar for the manufacture of brandy is formed an oil, called by distillers *füsel oil,* which contains margaric acid.* When sugar-canes are stored in warehouses, a waxy substance sometimes forms in them, which much diminishes their value, as showing that their contents have partially undergone decomposition. But the most beautiful instance of this transformation occurs in nature. While the fruit of the olive tree is forming, the sap of the stem is sweet and full of starch; it continues so till the product, which makes the tree valuable, begins to swell the berries: then, in exact proportion as the oil is elaborated, the saccharine matter decreases in that which supplies the nutriment to it. When the harvest is ready, not a trace of sweetness remains.*

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* Hoffmann, Grundlinien der physiolog. Chemie.

These instances are evidence of the possibility of changes occurring of a less simple nature than had been suggested, and of the capability of other elements of food for conversion into fat.

Between the two extreme opinions, of which the one views the fat already formed in the aliment, while the other considers it to be elaborated in the blood, there is room still for a third. Sugar, starch, and the substances related to them, may, by the action of some of the secretions of the body, undergo in the intestines a fermentation similar to that which we have above described: they may be converted into fat before they are taken up by the lacteals.

This conversion would take place within the boundaries of the individual body indeed, but still external to its actual substance; in the range of its action, but still not the vital act of one of its parts.

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* Schleiden's Botanik, Bd. i. S. 183.

Now, if this opinion be the correct one, animals will still fatten best on oleaginous food, because the lacteals will not then be dependent on the cookery of the stomach and of the other viscera to prepare their food for them, but will take it ready-made. But still, when starch or sugar is supplied to them in abundance, with but a small quantity of oily matter, they will be able to increase that quantity, and, like faithful servants, return us our own with usury.

We should expect, *à priori*, that a small quantity of oil would be required to commence the action; that is quite analogous to what we know of other fermentations, both from manufactures and the laboratory of the chemist. We should anticipate this *à priori*, and our anticipations are quite justified by experiment.

We have the highest authority for learning wisdom from the bees, and here is a case where we may gain physical as well as moral knowledge from their doings. Huber and Gundelach* had stated that bees possess the power of forming wax from sugar. Others, however, on trying the experiment of shutting bees up with loaf sugar, could not succeed in getting them to construct their comb; and, therefore, these statements were discredited. The bees, when thus restricted to the use of pure sugar only, either would not build at all, or else made so little wax that the quantity might be easily accounted for by that which they naturally retain in their bodies. But MM. Dumas and Edwards,* conjecturing that possibly these failures might arise from the unnatural position in which the bees were placed, put the matter to the test in a different way. They first ascertained how much wax, on the average, is contained in the body of a bee, and then how much wax in honey. Then the swarm was shut up in a closed hive, and supplied, not with sugar, as the others had been, but with their natural food. The animals continued to be industrious; but instead of constructing only so much comb as might be derived from the wax of their bodies added to the wax of the honey, that which they formed was three times as great as could be thus explained. There could be no other source of this additional creation than the sugar of the honey, and from that we must conclude that it arose.

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* Naturgeschichte der Honigbiene, 1842.

The fattening powers of sugar in health are known to all by the instance quoted by Galen, of the slaves in Italy who got fat during the fig and grape season,† and by a similar observation made on the labourers among the canes in the West Indies. I have heard, too, that the starved natives in New Holland always get plump during the season when they can procure honey, in which they largely indulge.

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* Annales de Chimie et de Phys., vol. xiv. p. 400.

† Galeni de Aliment. Facult., L. ii. c. 9.

These instances induced me to hope that similar good results might follow its use in the emaciation of disease. I persuaded Dr. Cotton to test its power on 25 of the out-patients of the Consumption Hospital. But it does not appear to have the same effect on sick people as it has on the healthy; for, though it did no harm, yet it did no good.

M. Boussingault and M. Persoz have still further investigated the same point in respect to the higher animals, to ascertain whether they too had the power of forming fat from that which does not contain it. They found that, in the fattening of geese, the oleaginous matter formed in the body of the bird was more than double the quantity which was contained in the maize consumed. This fact does not depend on one individual experiment. M. Persoz submitted ten, and M. Boussingault six geese, to a most accurate series of tests by the balance, so that there can be no possible fallacy in the method of observation. The experiments appear to me decisive, and much more so than any performed on the larger animals, from the facility which the method employed, of feeding geese by cramming, affords to administer a certain quantity of even an unpalatable food. Their excrements, too, are much easier to collect than those of animals who make liquid urine, and the amount easier to estimate.

It would appear, too, that not only those proximate principles which contain oxygen and hydrogen in the proportion to form water (and are, therefore, easiest consumed by the respiratory combustion),—not only these are capable of being turned into fat, but also the more complex nitrogenous compounds, such as albumen and gluten, have the property of conversion into the same *non*-nitrogenous class of substances. Wurtz has ascertained that, under the influence of alkalies and heat, or by a spontaneous alteration, albumen gives origin to butyric acid; and M. Boussingault has obtained similar results from the allied substance, gladiadine.* And the well-known change of muscular fibre into adipocire, as shown in the facial muscles before you on the table,† is an instance of the same decomposition. This consideration would be insufficient without the test of an experiment on an animal; but this additional evidence has been afforded by the industry of M. Boussingault. In two ducks fed on albumen, and in two fed on pure caseine, there was more fat found in the intestines than was to be accounted for by any other supposition than that of its being formed as has been stated.*

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* Annales de Chimie, vol. xiv. p. 482.

† This was a very beautiful specimen of part of a human face completely converted into adipocire, which was kindly lent to me out of the Christ Church Museum by Dr. Acland, Lee's Reader in Anatomy at Oxford. Some interesting experiments on the change of muscle into fat by a purely artificial process were detailed by Dr. Quain, in a paper read at the Royal Medico-Chirurgical Society, April 1850.

Animals, therefore, form fat from substances which do not contain it.

Thirdly. But do animals, besides taking fat from plants ready-prepared, and making it by the assistance of their secretions from other proximate principles, also find a source of it in the other tissues of their own bodies?

An observation made by M. Persoz would seem, at first sight, to lead to this conclusion. He found that, in geese put up to fatten when at their full growth, the increase in weight of the birds was less than the amount of fat formed would have led us to expect; that is, that the whole weight of the animal did not so rapidly augment as the weight of the fat. Thence he concluded that some portion of it was formed at the expense of the muscular fibre. But cannot the loss of muscle or bone perhaps be explained in another way? The birds are evidently in a diseased condition. If not killed at the moment they attain their maximum gravity, they begin to decline, and are reduced with great rapidity; showing that the good condition of the animal in the eyes of the *gourmet is* an actual state of disease. It is by no means a forced explanation of the above facts to assume that, while the fat was increasing in a morbid degree, the muscles were at the same time wasting from interstitial absorption, and being carried off by the urine. In the same way I would explain that seeming change of muscular fibre and the coats of arteries into fat, which occurs in some cases of atrophy, and is most usual in emaciated persons and unhealthy tissues. The protein compounds may be absorbed and conveyed away from the system as urea, and, not being renewed, are replaced by the fat derived from the diminishing adipose tissue.

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* Annales de Chimie et de Phys. vol. xviii. p. 462.

What, then, are the conclusions to which we are naturally conducted by a review of these experiments, and the deductions from them?

We are led to conclude—

First. That the favourite material which nature employs in the production of fat is oleaginous food.

Secondly. That it is formed also from other proximate principles of diet, possibly from *all* proximate principles.

Thirdly. That there is no evidence adduced to show that it is formed from the other corporeal tissues, but that in unhealthy states of constitution its increase may coincide in point of time with their decrease.

I trust I may be pardoned for recalling your attention to these facts and experiments, of which the details are accessible to all. The conclusions are so important in every point of view, in their practical and scientific bearing, in their relations to physiology, economy, and even politics, that they cannot be too often brought before us; we cannot too often take stock, as it were, of our knowledge on these points.

The next part of the subject which I shall consider, is that which relates to the accidental circumstances under which fat forms in the economy. We have examined what we know of the material cause: now let us see how this matter, the ὕλη of which the building is to be built, as Aristotle picturesquely calls it, is to be brought under the scope of the efficient cause.

These circumstances, varied infinitely in individual instances, are, however, capable of being brought under one common expression. For the formation of fat, it is necessary *that the materials be digested in a greater quantity than is sufficient to supply carbon to the respiration.*

I would here remark, that by digestion I do not understand merely the mixing of the food up into chyme, which may be designated its second cooking in the stomach, nor yet the absorption of it by the lacteals or veins into the circulation; but I mean the conversion of it into healthy blood. Now it appears that the animal body is capable of taking up for this purpose, from the substances passing through the intestines, only a certain quantity at a time of each of the elementary principles of food. You may put as much as you please of that elementary principle into the bowels, you may even drench the circulation with it, but no more than its due allowance of the simple aliment will the blood appropriate to itself. And until it is made into blood, it cannot be converted into carbonic acid and water by the respiration, for the formation of animal heat.

This peculiarity of the animal body seems to afford a ready explanation of the facts ascertained by the French commission of inquiry on the nutritive powers of gelatin. The animals on which the experiments were tried, died in a state of starvation, though they devoured an abundance of starch, or of albumen, or of fat. And why? A certain quantity, and only a certain quantity of each separately, is capable of being assimilated with the blood, and that quantity is less than is wanted to supply carbon for the respiration. For example, in a duck crammed with fibrin by M. Boussingault, there was absorbed into the system, to be assimilated or burnt, in thirteen hours and a half, so much of the said fibrin as would contain somewhat under thirteen grammes of carbon. Now, for the supply of the respiration, to form the quantity of carbonic acid which the animal gives off by the lungs, in the same time there were required more than sixteen grammes of carbon. It must of course consume its own tissues—in other words, die of inanition.

It is of no use for the alimentary matters merely to be taken by physical absorption into the body. They cannot be used for respiration unless made one with the blood. Ducks fed for some time upon lard, by M. Magendie, were so saturated with oil, that it exuded even from the ends of their feathers; but for all that, there was an insufficient supply made into the life-giving stream to prevent the creatures dying in a state of starvation.

But reflect on the altered circumstances of the case, when, in addition to the quantity of fibrin which it is capable of digesting, the blood also receives its allowance of gelatin and of oil. The taking-up of a considerable quantity of the one does not offer any impediment to addition of even a superfluity of the others. Then there is enough matter in the blood, not only to supply the lungs with carbonic acid, but to replace the absorbed tissues, and to allow the oil to be deposited as fat. This is the rationale of fattening under the use of a superabundant diet.

On the same principle, if the lungs excrete less than usual, from the want of their accustomed exercise, a similar result takes place. To prepare animals for market we coop them up as much as is consistent with the retention of a certain degree of health, that less carbon may be consumed by the lungs out of the food we give them.

The fattening which arises from want of light may be explained as an exemplification of this law. Mr. Morton took five sheep of nearly equal weights, and fed each with a pound of oats a day, and as much turnip as they chose to eat. One was fed in the open air, two in an open shed, one being confined in a crib; two more were fed in a close shed in the dark; and one of these also was confined in a crib, so as to lessen the amount of exercise it should take. The increase of *live* weight (which in butchers' language means the weight of the whole animal, not of the quarters only), and the quantity of turnips they respectively consumed, appear in the following table*:—

	Live Weight.		Increase.	Turnips eaten.	Increase for each 100 lbs. of Turnips.
	Nov. 18.	Mar. 9.			
	lbs.	lbs.			
Unsheltered	108	131·7	23·7	1912	1·2
In open shed	102	129·8	27·8	1394	2·0
Do., but confined in a crib	108	130·2	22·2	1238	1·8
In a close shed in the dark	104	132·4	28·4	886	3·1
Do., but confined in a crib	111	131·3	20·3	886	2·4

A reference to the numbers will show that the sheep left with such a degree of freedom of motion as preserved his health, but deprived of light, made much greater progress, and required less food to make that progress, than any of the others.

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* Johnston's Agricultural Chemistry, p. 897.

We cannot ascribe the condition of the animals to want of exercise, because it may be observed that the sheep which were most closely confined in the cribs did not increase so much, but may with more consistency view it as a result of the deprivation of those chemical changes which we well know are favoured by the sun's rays.

"Perhaps the greatest refinement in fattening is exhibited in the manner of feeding ortolans. The ortolan is a small bird, esteemed a great delicacy by the Italians. It is the fat of this bird which is so delicious; but it has a peculiar habit of feeding, which is opposed to its rapid fattening —that is, that it feeds only at the rising of the sun. Yet this peculiarity has not proved an insurmountable obstacle to the Italian gourmands. The ortolans are placed in a warm chamber, perfectly dark, with only one aperture in the wall. Their food is scattered over the floor of the chamber. At a certain hour in the morning the keeper of the birds places a lantern in the orifice of the wall; the dim light thrown by the lantern on the floor induces the ortolans to believe that the sun is about to rise, and they greedily consume the food upon the floor. More food is now scattered over it and the lantern is withdrawn. The ortolans, rather surprised at the shortness of the day, think it their duty to fall asleep, as night has spread his sable mantle around them. During sleep, little of the food being expended in the production of force, most of it goes to the formation of muscle and fat. After they have been allowed to repose for one or two hours, in order to complete the digestion of the food taken, their keeper again exhibits the lantern through the aperture. The rising sun again illuminates the apartment, and the birds, awaking from their slumber, apply themselves voraciously to the food upon the floor; after having discussed which, they are again enveloped in darkness. Thus the sun is made to shed its rising rays into the chamber four or five times every day, and as many nights follow its transitory beams. The ortolans thus treated become like little balls of fat in a few days."*

Here several applications of the same principle occur at once:—Absence of waste from motion, in the extra sleep which the birds get; absence of the usual chemical changes from the influence of light; an unusual supply of food, from their being deluded into taking four meals a day instead of one; and great facilities for digesting that food, by being removed from the view of those external objects which naturally arouse the anxieties, and so hamper the digestion, of waking mortals.

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* Whiteside's Italy.

A cruel advantage is taken by the natives of India of their knowledge of the above fact. The wild hog will not fatten in confinement, because he is constantly looking about for some way of escape, and is harassed by the prospect of his prison walls. They therefore sew up the eyelids of the animal, and then he rapidly becomes fit for the table.

We shall see further exemplifications of the same law when we come to review fatness as a disease in the human subject, and shall find pathology in this case, as in most others, to receive its chiefest lights, and the art of healing pain to look for its surest guidance, from rational physiology.

CHAPTER III.

Assimilation of fat—effected through the agency, not of the stomach, but of the pancreatic juice. Experiment on a rabbit described. Drs. Bernard and Frerichs' observations on this point. Emulsioning power of the pancreatic juice. Its further action on starch, converting it into sugar. Fat in the blood in a state of health.

We have seen in the previous pages the uses to the animal economy which fat subserves, and have reviewed, so far as to bring under one law, the chief circumstances under which living creatures are able to acquire it, or make it so far a part of themselves as to be turned to those uses. But there seems reason to believe that their own organs bear at least an equally important part in this manufacture. I mean that it is necessary, not only that proper fattening food should be presented, and that external circumstances should be favourable, but also that the animal itself should be in a fit condition to receive it,—should be capable of making a good use of the opportunities offered. For do we not daily see cases where, even under unpropitious circumstances, fat continues to accumulate, and others where, in spite of every care to provide the material, none will be formed?

Our subject, therefore, naturally leads us to trace the fat-forming food into the body, and to see if recent scientific researches will aid us in at all unravelling the mysterious paths by which it enters the life-giving stream of the circulation.

To determine what portion of the digestive apparatus, and which of its secretions, are most concerned in the appropriation of the fatty elements of the food, has lately been made a frequent subject of experiment. That the stomach has nothing to do with it we should have conjectured, from our knowledge of the functions and usual state of that organ. The acid mucus secreted by its walls has no effect on oily substances. The large quantity of fluid which it generally contains keeps the globules of fat floating free in the cavity, without touching its mucous membrane. The nitrogenous principles, and all substances capable of being acted upon by the gastric juice, and being made soluble in water, fibrin, starch, sugar, &c., are probably taken up, to a certain amount, by the veins of the stomach. The alimentary mass thus passes out of the pylorus in a more concentrated form, and containing a larger proportionate quantity of fat than the food eaten. Thus M. Boussingault found that rice taken from a duck's gizzard contained much more oil than the same rice before it was eaten; and in the small intestines the chyme held nearly five per cent. of the substance, while rice presents only a few parts in a thousand.

But in the duodenum the chyme is mixed with two fluids, the bile and the pancreatic juice, both of which have with much reason been supposed to act chemically on fat. Stale bile is well known to dissolve oil by its alkaline reaction, and the use of it in removing grease spots from woollen textures is familiar to all dyers and scourers. But it is questionable whether in the body, and free from the gall-bladder mucus, it is alkaline, as it is seen to be after death. Our knowledge must be derived from living, not dead bile. Sir Benjamin Brodie deduced, many years ago, from experiments made on the bodies of cats, that the bile does dissolve fat; but in these animals the ducts of the liver and pancreas anastomose, so that he had no opportunity of separating the actions of the two secretions.* He proves that the two jointly render fat capable of being taken up by the lacteals, but does not test their distinct powers. Indeed, in most animals that is impossible.

However, in the rabbit a strange freak of nature presents the desired opportunity. In it, the ductus choledochus empties itself close to the pylorus, and the pancreatic solution enters the intestinal canal eleven or twelve inches lower down, the duodenum being singularly long for an animal so small. By feeding a rabbit on a meal of fatty substances, after a previous fast, and killing the animal about three hours afterwards, while the mass may be supposed to be passing gradually through the upper parts of the bowels, we are able to observe, first, the effect of the admixture of bile, and, twelve inches lower down, of the pancreatic fluid on the fat taken. Were the fat dissolved by the bile, evidence would be exhibited of the fact by its being taken up into the lacteals, and producing in them the well-known milky appearance. But in the specimen which is here submitted to you, it may be seen that such is not the case; the lacteals are filled with clear fluid, till we come to the entrance of the pancreatic duct. Immediately that is passed, you see them leaving the intestines in great quantities, as white as milk. It is, therefore, the pancreatic juice which renders the fat of the food capable of being absorbed by the lacteals.

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* Quarterly Journal of Science, Jan. 1823.

The experiment shown is one of very easy performance, and involves no cruelty, for the animal will eat heartily of green food immediately after the fat is administered, and is killed in the ordinary rapid way. Several experiments confirmatory of it have been made by Drs. Bernard and Frerichs on the secretion drawn by a painful process from living dogs. There are several reasons why they are not exhibited on the present occasion. First and chiefly, I am not convinced that we have a right to torture a creature subject to our rule merely to gain knowledge. The effect of the infliction of such pain may possibly not be injurious to others, but I know it would harden *my* heart, and therefore I will not do it. But, besides that, these delicate animal fluids change so easily when out of the body, that I think it hazardous to trust to observations made upon them so situated.

Dr. Bernard thinks that there is something *sui generis* in the action of pancreatic juice beyond what it exhibits in its power of forming an emulsion with the oil. He thinks that it causes a decomposition of the oil into glycerine and an acid,—margaric, stearic, or oleic, as the case may be.* Professor Frerichs,† however, does not allow this, but thinks that the emulsion before mentioned alone takes place; for the pancreatic fluid, when it has stood for some time, allows the oil-globules to unite again, exactly as happens with the serum of blood and saliva. The last opinion seems supported by the fact, that the oil appears in the lacteals in substance, and it is difficult to conceive the purpose to be answered by such a decomposition as has been suggested.

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* Archives Générales de Médecine, p. 73, Jan. 1849.

† Wagner's Handwörterbuch der Physiologie. Quoted in Monthly Journal of Medical Sciences, February 1850.

Dr. Bernard's reason for attributing to the pancreatic fluid this decomposing power is, that when butter is mixed with it, and allowed to stand for a certain time, the odour of butyric acid is evolved from the mixture. It can hardly be allowed that this is a sufficient argument, for when in contact with any animal substance undergoing a chemical change (which pancreatic juice does, with great rapidity, *out* of the body), an interstitial fermentation of the butter itself is likely to occur, and so give rise to the acid smelt.

The pancreatic juice has yet a further action on one of the elements of the food, which bears a certain relation to the subject we are considering; it is capable of converting starch, by digestion for an hour and a half at 86° Fahr., into dextrin and sugar. This observation, originally made by Bouchardat, has been confirmed by Frerichs (loc. sup. cit.) Now, in an inaugural treatise, published in 1845, at Halle, by Dr. J. H. Meckel, entitled "De Genesi Adipis in Animalibus," the author has brought forward some evidence which induced him to believe that sugar may be converted by the bile into the oily acids. If his conjectures are correct, starch may be converted into sugar by the pancreatic juice, and that sugar into fat by the bile. Thus we have the transformation of amylaceous substances distinctly traced, and the use they are of in supplying adipose matter to the system explained. And we shall thus understand the results of the experiments detailed in a former lecture, where starch was found to fatten. It is right, however, to say, that these experiments of Dr. Meckel's have not received confirmation from any one who has specially devoted himself to the study of chemistry.

As soon as fat has passed by the lymphatic circulation into the blood, it seems to be very rapidly appropriated to the purposes for which it is designed, for in the healthy vital fluid very little is to be found. That quantity which can be discovered is much altered in character and chemical behaviour. Some portion of it is in union with phosphorus; and as that substance is more likely to be part of some destroyed tissue than to be derived from the food, it is a more probable conjecture to suppose the fat it is united with to be the result of destructive than of nutritive absorption. A further evidence in favour of the conjecture which I have ventured to throw out, is afforded by an experiment before cited of M. Boussingault, who found that in ducks fed with lard the quantity of fat in their blood did not exceed that which existed in the blood of the same animals when killed after having been for some days without food.* But the rapidity with which it leaves the blood, and the slight trace found therein, is no evidence that it has not gone through that common thoroughfare where the passengers in and out of the body meet in their journeyings. What is more certain than that the sugar of diabetic urine all comes ready-formed from the circulating stream? Yet how little is found in the source!

Once in the blood, the fat may be consumed for the purposes of the respiration, as we have seen when reviewing the chemistry of the substance; or it may be stored up in the vesicles prepared for its reception, into which it is poured after the manner of a true secretion.

Having carried the fat thus far, we might stop to speculate on the possible employment of it in controlling and assisting cellular growth, the formation from it of the nucleoli of new life. But the observations on this point, though aided by the powerful mind and eye of Mr. Gulliver, can hardly yet be called knowledge; nor can any deductions subservient to man's use yet be made from them. It would not be consistent, I conceive, with the design of the founder of this lectureship, to direct our attention to those subjects which, sweet resting-places as they are to a philosophic mind, cannot supply laws of action, and which are wittily compared by Lord Bacon to nuns professed, living indeed to God's honour, but barren —"ut virgo, Deo dicata, nihil parit." It is our duty to proceed to that which is "fruitful of operations and inventions" for man's physical comfort.

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* Annales de Chimie et de Phys., vol. xxiv. p. 460.

CHAPTER IV.

Relations of man to oleaginous food. His instinctive desire for it. Not equal at all periods of life. Especially developed at puberty. Anecdote illustrative of this. Association of the fact with the observations made on the quantity of carbon exhaled. Practical importance of fat in the human economy. Observed by prize-fighters. Danger of excess.

THE instinctive desire shown by all nations for an oily diet, and the association of this substance with ideas of luxury in all times, shows the value of a certain amount of it to a man's comfort. The "butter and honey" of the prophet used as a phrase for royal food, and the reference in almost every other page of the Bible to oil as a luxury (though it could have been no *rarity* in a land peculiarly described as "a land of oil olive")—these are sufficient to show its estimation among the Hebrews. The Hindoo sepoy, when he devours his gallon of rice for a meal, will spend all the pice he can get on the clarified butter of the country; and "as good as ghee!" is his expression of unqualified praise. It was an error in Dr. Liebig to state that oily foods are an object of disgust to natives of hot climates; all races of men require them and seek after them, and the taste of the Esquimaux, so often quoted, probably depends principally on the abundant supply of the article which the sea places at his disposal, coupled with a scantiness of other provision. Throughout mankind there is an instinctive desire for this food, which, as we have seen, nature finds the most ready material for forming the adipose tissue of the animal body.

This desire is not, however, equally developed at all stages of our life.

The case is exceptional, and evidently due to an idiosyncrasy, where fatty food is disliked by a healthy, unprejudiced adult. But it is not the same with children; their repugnance to this article of diet is too commonly observed to be a mere instance of fanciful prejudice, and where it does not exist, education and constraint will usually be found to explain the peculiarity. It is, I think, more noticeable in girls than in boys, and inasmuch as the time of puberty is more marked and definitely fixed in the female sex, it can in them with greater precision be traced in its association with that period.

The following anecdote shows what a strongly marked line can be drawn between the child and the woman by the change in their relish for food, and how the period of full development is not exhibited in this or that organ, but in the whole person simultaneously. It was related to me by a surgeon of deserved eminence in this town, and on whose accuracy I can depend.

He was summoned about five-and-twenty years ago to St. Alban's, to see the apprentices who to the number of sixty were employed in the Abbey silk-mills at that place. A great number of the inmates of the house were suffering from a variety of obscure symptoms of various degrees of intensity. On examination of the invalids he came to the conclusion that their illness depended on the poison of lead, and advised their being treated in accordance with that opinion. In the meantime, specimens of the water were reserved for analysis, the places where the milk was kept, made of white crockery, were examined for the metal in question; but nothing deleterious was found, nor had any part of the building been recently painted. But still fresh cases kept occurring, and those who had recovered relapsed, and had colic a second time. The cause of the evil was evidently permanent.

Now the surgeon in ordinary attendance had been loth to agree to the diagnosis which assigned the symptoms to lead poison, from some connexion which seemed to exist between the occurrence of the disorder and the uterine functions. Not only were the catamenia arrested in those attacked, but it was observed, that all the girls under puberty had wholly escaped, while all who had ever menstruated, from the maiden of fourteen to the matron superintendent, were affected in various degrees.

The search was still pursued for the avenue by which the lead had entered the system, and the mystery was at last solved on probing to the bottom of a trough in which salt pork was kept. It was found to be lined with the deleterious metal, and to have impregnated the outside fat of its contents with the poisonous carbonate. Inquiries were then made of the apprentices themselves for some link which would connect this discovery with the anomalous escape of some parties, and the greater risk of others.

It appeared that this fat pork was placed on the table three times a week, but never alone, being always accompanied by some fresh meat, and the girls were at liberty to take which they liked. Now on questioning them it came out, though not previously observed, that the older apprentices and adults always ate the pork, while the little girls—all, that is, under puberty—invariably chose the mutton. The disease, which had attacked the one and spared the others, was a test of the truth of the statements which they had made.

This newly-acquired desire for fat meat at the age of puberty is a most interesting and curious fact. It is more observable in the female sex, from the deeper influence on the vital actions of the whole individual which that change exerts in them than in males. But how shall we associate this fact with what we know of the other corporeal functions at this period? The mere growth of the body, the increase in size, is much the same before and shortly after puberty. Nor is it easy to conjecture what the evacuation of the catamenia can have to do with oleaginous matters.

There is, however, a change that takes place in the excretion of one organ, which modern chemistry has taught us to ally with the chemical changes of all carboniferous substances in a strict and peculiar manner. It is to the lungs that we would look for assistance in explaining the circumstances before us.

It appears from the researches of MM. Andral and Gavarret,* that the excretion of carbonic acid by the lung increases in quantity, during childhood, very exactly in proportion to growth, the augmentation steadily progressing up to the period of puberty. In boys it would seem but little affected by that new function; but with girls the case is entirely different: there the occurrence of menstruation puts a complete stop to the increase in the amount of carbon thus passing away, and sometimes even causes it to make a retrograde movement. Thus a child of thirteen years of age exhaled 6.3 grammes of carbon hourly; a girl of fifteen years and a half, who had not menstruated, 7.1 grammes; while another, also of fifteen years and a half but in whom the catamenia had flowed regularly, gave out only 6.3, the same quantity as the one two years and a half younger. The same observation was the result of experiments on healthy women of twenty-six, thirty-two, and even forty-five years of age, who still continued to experience their monthly evacuations. After, however, the change of life has occurred, the exhalation of carbonic acid begins to increase again, and in elderly women is much the same as in elderly men. What is still more curious is, that when, from any cause, either pregnancy or illness, the catamenia are stopped, then temporarily the pulmonary excretion is augmented, and occupies a vicarious position in respect to the other functions.

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* Annales de Chimie et de Phys., vol. viii. p. 129.

The uterus, then, and vital actions which are expressed by it, play an important part in the decomposition of carbon in the system. When we reflect on this, changes in the digestion which supplies that carbon, and changes in the instincts which supply the digestion, will not surprise us, when they accompany the radical alteration which the generative organs experience at puberty.

The acquisition of fat is not without an important practical bearing on the health. A certain power of resistance to external physical influences seems to depend very much on the maintenance of a proper proportion of this substance in the body. Prize-fighters have long since found that to make it safe for them to undergo the severe treatment which the exercise of their calling entails, they must be at least up to a particular weight. This weight varies, of course, according to the individual's constitution. One pugilist will describe himself as belonging to the heavy, another to the light weights, not using the expression to denote his actual gravity, but to indicate what proportion to his height it ought to bear—that is, whether he ought to be light or heavy for a man of his inches to enable him to enter into a fight without peril. The number of pounds being ascertained, if he has trained himself too much, he will feed himself up to the mark; for he knows by experience, that though fat will somewhat impede the activity of his muscles, yet, without it, the blows he receives would be followed by more severe consequences. Now, it is clear that the augmentation of weight thus experienced is not muscle, for the previous training has brought that tissue to its fullest development; and it is too permanent to be water: so that I think the conclusion I have suggested is the true one, and that it is fat which gives the power of resistance.

On the other hand, excess in this respect is equally injurious with deficiency. Indeed, practically speaking it is more injurious, because the dangers to which it exposes the individual are more likely to be induced by the ordinary course of our lives than are the dangers which defect is subject to. By an over development of adipose tissue the capillary system of blood-vessels is, as I before pointed out, vastly increased in aggregate bulk, while at the same time no corresponding increase takes place in the forces which supply the means of action to those capillaries. Hence there is a comparative weakness in the conservative vital actions; and an injury to any part of the body, especially to those parts which, physiologically speaking, are most distant from the fountain of life, is less easily repaired. Thus in obese persons, erysipelas, low inflammation, and gangrene, supervene on slight accidents, and operations are more dangerous in their consequences. Practically, therefore, a similar result arises in the case of excess and deficiency; but with, I think, this difference, that whereas the first gives rise to bad effects after small and common accidents, the evil of the latter is only experienced when the system is put to a severe strain. We are all liable to tumble down and break our shins, which if we are obese will be a more serious accident than to others, but few of us wish to prepare ourselves for sustaining the punishment of a pugilist, which doubtless requires a full allowance of fat. But this subject will be further pursued when we come to speak of corpulence and its consequences as a disease of the human frame.

CHAPTER V.

Weight the best measure of fat, being little affected by bone and muscle, but greatly by adipose matter. Value of observations on the weight, especially of emaciating persons.

A CERTAIN amount of fat being requisite for the ordinary use of the human body, and an excess being allowed in this, as in every other constituent of the frame, to be of the nature of a disease, it becomes of great interest to feel confidence in the modes we possess of judging of this excess or its opposite. The balance is the method most commonly employed, but many are disposed to view the information it affords more as an indication of the general state of the whole of the tissues, than of what I believe it much more clearly points to, the decrease or augmentation of adipose matter. It is contended that among the variety of matters of which the body is composed, alterations in weight may as well be considered as an index of unnatural states in one as the other; of the bone or muscle, to take the two largest in quantity, as much as of fat. I shall not consider, therefore, that I am consuming time unnecessarily if I occupy attention for a little with some reasons why changes in the fat are those which are peculiarly indicated by changes in weight. While an animal is in a growing state, and till it arrives at its perfect size, the muscles, bones, and in fact all the parts which constitute the bulk of the body, must be in the receipt of daily additions to their substance. They must constantly appropriate somewhat more than they part with by interstitial absorption. But when the period of full development is attained, very little further increase of the essential organs of motion takes place, certainly not such an increase as to materially alter the average weight of the animal. Do not let me be misunderstood: the continual and exclusive use of a single muscle, or of a set of muscles, may, it is true, augment them appreciably in size; and, comparatively speaking, the deltoid of the blacksmith and the gastrocnemius of the runner are to the eye much larger, and weigh no doubt much heavier, than the corresponding organs in one of us; but still that augmentation of his weight is small compared with the weight of the whole body. So, too, one skeleton may be a great deal more massive than another, as a visit to any anatomical museum will show; but yet that comparative massiveness will make but little alteration in the total weight of the creature. For, in point of fact, the bony framework is but a small part of the body, and might be doubled in weight without the balance showing that the man was in any singular degree above the natural size. An ordinary human skeleton rarely comes up to fourteen pounds, and for a man's weight to vary a stone from the standard of averages is of no account.

An example, which I will cite, of hypertrophy to a remarkable extent of the bones and muscles, will point out to what a small degree these organs affect the weight. The measurements below were taken from a French gardener, a cast of whose hand I have in my possession through the kindness of Mr. Brent.

Circumference	of	Neck	18	inches.
"	"	Breast	44⅓	"
"	"	Forearm	13	"
"	"	Wrist	8½	"
"	"	Palm of hand . .	11¼	"
"	"	Calf	17	"

If you compare these with the corresponding parts in your own persons, you will easily judge what a strange ungainly figure he must present to the eye.* Yet he weighs, clothes included, but sixteen stone. You would never have found by the balance that his bones and muscle were of such huge dimensions. The reason is, that he has but very little fat upon his body.

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* The tastes and calling of this man offer a singular contrast to the apparent destination of his body. Those mighty thews were devoted to training delicate flowers, and the great coarse fingers I showed to my audience were famed for their skill in tying up ladies' bouquets.

Place by the side of this man's weight that of some small-boned, small-muscled, but obese person, such as you will find in a table further on, and the smallness of the increase in weight caused by the more solid structures is very striking as compared with that which is due to adipose matter. There is a man, No. 31 in the Table of Obese Persons, small handed and not muscular, slim in his youth, who now weighs twenty stones; his height is five feet ten and a half inches, and the average weight of men of his height is about twelve stones. He, therefore, probably carries about him eight stones of fat. Yet these seventeen stones do not make him nearly so remarkable a person to look at, so different from the ordinary class of mankind, as the two or three stones of bone and muscle, which Cordonnier, the Lísle gardener above instanced, possesses.

When, then, an adult animal grows heavier, we may attribute the increase in some small degree to bone and muscle, if we have proof of activity and strength increasing at the same time. But it is not reasonable to assign any great augmentation to this cause, because we may know from the instance above cited, and similar ones, that where this rare hypertrophy does take place, a misshapen and otherwise remarkable figure is necessarily the result.

Any great increase may, for all practical purposes, be safely reckoned as due to fat deposited in some part.

I am disposed, then, to think we cannot have a better test of the increase of fat than in the indications afforded by the balance. For all practical purposes we may consider that the bone and muscle are of a certain weight in proportion to the size of the creature, and that the excess is adipose matter.

We must of course except the extraordinary cases like that of the French gardener quoted above, and we must also except some cases in which an amount of weight proportioned to the exertions of the body is sometimes lost under unusual circumstances. As, for instance, in a case related to me with details by Mr. Cutler, where a gentleman lost ten pounds in 20 minutes, by riding a steeple-chase. The loss here is probably water; as simple rest, which can only act by permitting imbibition from the air, restores in a great measure the lost weight.

It must also not be forgotten, that, as stated before, young animals stand in a very different position with adults as to the cause of increase in weight; in the first a great part is *probably* due to growth of muscle and bone, while in the latter it is *almost certainly* due to fat, and may be taken as a test of improved condition.

This fact has not been sufficiently borne in mind by some of those who have attempted to test the value of different aliments. We find in the experiments made at the Glasgow Bridewell, as recorded in the Report presented to Parliament in 1840,* that classes of men and boys promiscuously mingled are put upon certain diets, and the mean increase in their weight taken as a proof of the efficacy of the food in fattening. The consequence is, that the experiments prove nothing, but yet they are occasionally made the basis of fallacious arguments on this vital question. Even Professor Liebig fell into the same snare in selecting for the medium of his experiments a goose which had not come to its full growth, and assuming that all its augmentation was to be assigned to fat.†

If due allowance be made for these exceptions, I believe my position, of the value of the balance as a test of fat, a most valuable one.

And of what part of the body is it more important for the physician to test the condition than this? If it is gradually decreasing in a person already too spare, he may feel sure that some hidden cause is at work, whose operation will finally, if unchecked, destroy health and life. The ear, however highly it may be educated, will often fail to detect a lung disease, of which the gradual consumption of the fat affords the only suspicion. Or, when the pain is removed and the cough gone, we may flatter ourselves that our cautious prognosis was misplaced, and that a real cure is effected, till a deficiency in fat, shown by the want of weight, is found to remain, and by its progression to justify the worst suspicions.

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* Fifth Report of Inspectors of Prisons, iv.—Prisons of Scotland.

† M. Persoz, in Annales de Chimie et de Phys., vol. xiv.

The fat, or, what I here view as synonymous, the weight, may be made an index of the benefit our remedies are conferring, may tell us when they are doing good, and give us a hint to stay our hands when the patient has had as much as is beneficial. Thus, while taking tonics with advantage, a spare person will steadily increase in weight; but a time comes when the system has had sufficient stimulus, and each dose of the medicine he takes is more and more injurious. No doubt the patient and physician will in time find this out to their cost by the bad symptoms which arise; but they might have found it out much sooner by the scales. Even before the feverishness, or the headache, or the constipation, or whatever may be the result in the individual case, comes on, due notice is given by loss of weight, and if this warning be attended to, the unpleasant consequences of the remedy may be avoided. But it is unnecessary to quote more examples, the cases in which it would be of advantage to know the progressive or receding weights of our patients are sufficiently obvious, if the attention is once drawn to this simple observation.

Why so little regard is paid to changes in weight by the profession at large, is difficult to understand; unless the observation made by a crafty politician on the faith of the vulgar is also applicable to men of science, and they are more disposed to trust to what is obscure and hard to observe, than to what is easy and obvious.* They will rather attempt to prove an uncertain negative by a laborious investigation, rather state doubtfully that a disease is not worse, because their fallible eyes or ears cannot find it to be so, than establish the affirmative of restored health, by observing that there is sufficient energy of system to form healthy fat. Or they will take the word of a cheerful patient that his health is improved, or trust to the variable indications afforded by his secretions alone, without testing them by an instrument so simple that it is in daily use among those who cannot read, but withal so trustworthy that it is taken for a type of the divine attribute of justice.

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* "Communi enim fit vitio naturæ, ut invisis, latitantibus, et incognitis rebus majis confidamus." — *Cæsar de Bello Civili*, ii. 4.

CHAPTER VI.

Application of observations on weight to life insurance. Light weights of phthisical patients. Average weights in health. Comparison of them with figures proportioned as well-known statues, and with the weights of obese persons. Variations in weight—sudden—progressive—in different seasons and in regular periods.

THE amount of fat required for the full and perfect resistance of the body, is different, as aforesaid, in different individuals, and will also vary according to their mode of life. Thus a man of letters will require less than a soldier, a soldier less than a prize-fighter. It is impossible, therefore, to fix any absolute standard of weight, and it is incorrect to look upon the average weight of healthy individuals in proportion to their height, as necessarily the proper one for every person. Still there are certain limits on each side of the average, the transgression of which shows a predisposition to disease, or even itself constitutes infirmity. If a patient is below the boundaries of healthy thinness, there is a strong presumption in favour of some cause existing which may account for his emaciation, and will tend to shorten life; and if that cause exists, he is, from the deficiency of fat less able to resist its influence. If he is above the standard of healthy corpulence, the natural defence becomes a burthen; he loses the power of resistance which was derived from the normal proportion being kept between the various tissues; the balance in fact, of the system, is destroyed. Can we wonder at this, when we reflect on the vast aggregate amount of capillary vessels distributed through the adipose tissue, and think that these are doubled or trebled in quantity in obesity? Can we be surprised that the individual becomes thus more liable to such diseases as arise from this defective balance; that he is prone to heart-disease, to apoplexy, and congestions?

The development of fat I consider an element of great practical importance in calculations of the value of human life. It is of the more importance, from the facility with which it may, in all but exceptional cases, be reckoned by the weight in proportion to the stature. In our species, the bulk of the frame is pretty accurately shown by the height, and consequently the quantity of fat which ought to be attached to that frame may be calculated. Its deviations from the normal proportion may therefore easily be arrived at, and can hardly be denied to lead to very valuable conclusions. What can add more to that examination which has resulted in the discovery of no disease, than to find that the weight is such as the healthiest usually possess? while, if a person is much above or below the standard, it is not necessary to discover any other bad symptom to pronounce the insurance of his life as above the ordinary risk. Were we confined to the observation of one single fact, by which to appreciate the probability of future illness, I do not know any which would teach us more than this; and when we have means of learning other circumstances, there is none which opens the ground better for investigation. If, for example, a proposal be sent from the country, backed merely with the opinion of a referee whom we do not know, that "no signs of disease are discoverable," and that "the proposer has a robust appearance," our knowledge of the tendencies of his constitution is small indeed. But if to this it be added that he is five feet eight inches high, and weighs eleven stone, we feel a certain degree of safety in accepting him. But should his weight be seventeen stone, a probable deposit of fat in the omentum and the heart occurs to us,—disturbance of the abdominal circulation, apoplexy, &c. are suggested, and the liability to these balanced and inquired about. A corresponding deviation from the natural weight, in the other direction, would in a similar manner lead to a more detailed examination of the chest, and a calculation of the possible existence of tubercle. When we remember that four-fifths of the losses at insurance-offices arise from apoplexy and consumption, the safety which they would gain by the simple observation above mentioned is obviously very important to those engaged in such enterprises. I may add, too, it facilitates much the explanations of the reasons for a refusal or acceptance, which the directors will sometimes require from their medical advisers; for it depends on a reasoning comprehensible to all, and capable of reduction to figures; so that we are thus enabled to follow the advice of the wise man of old, which bids us "deliver all things in number," and can avoid the vagueness of a mere negative opinion.

We are not without data from which to draw our conclusions on this point. Several labourers in the field of vital statistics have recorded the weights of the body in phthisis, and one among them, Dr. Boyd, has accompanied this observation by a most interesting account of the weights of the separate viscera. With the latter part of his task we are not here concerned, except so far as to notice that all the internal parts exceed the weight they ought to have in health, and therefore it is not to decrease in them, but in the external parts, that consumptive patients owe their lightness. From a paper of Dr. Boyd's in the Edinburgh Medical and Surgical Journal*, it appears that the mean height of 108 adult males affected with phthisis was 5 feet 7 inches, and the mean height of 103 of the same 90·25 lbs., or not quite 6 stone and a half. The mean height of 141 adult males of the same class, (viz. paupers from the St. Marylebone Workhouse), not phthisical, was a little more than 5 feet 3 inches, and their mean weight 134 lbs. or 9 stone 8lbs. Thus the mean height of the consumptive patients was 4 inches more, and their weight nearly one-third less. The loss of weight will be more strikingly shown by a comparison with the average weights of robust men, to which we shall presently arrive. How can we fail to see in this loss of weight an individual feature of the disease? how can we fail to appreciate highly the importance of such a facile and obvious guide to its discovery? And not only *a* guide, but sometimes *the* only guide; for in many cases, from the peculiar distribution of tubercular deposits or the unusual form of chest, or perhaps from external circumstances preventing an accurate examination, the ear may fail to detect pulmonary lesions; and the slight general symptoms may be made so light of, especially in a proposal of insurance, that they do not warrant their reference to severe disease; and yet the balance, sure and faithful, requiring no acuteness of the senses or suspicions shrewdness of observation, lets us into the secret of the defective organism.

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* Vol. lxi. p. 290.

A corresponding proof of the ease with which we may graduate the different degrees of obesity, and prove it to exist even in those who we have not seen, will be given shortly; but it will be right first to examine what we know of the AVERAGE WEIGHTS of HEALTH, in order that we may have a clearer idea of the deviations in diseased conditions.

The amount of fat required by different individuals for the enjoyment of high health, and consequently their weight, differs, as I have said, according to their occupation, and the demand it makes upon the strength of constitution. But at the same time this does not exclude an average weight as a standard of comparison, from which the deviations in each direction may be viewed; not, indeed, as absolute proofs of an abnormal condition, but as proofs relative to the other circumstances of the case. A very strong active man may be allowed to exceed to an amount which in a sedentary weak person would excite our attention. A man whose history shows him to have been always spare and weak, is naturally below the mark, but if he was formerly as stout as others, the lightness would arouse suspicion.

In a deeply interesting and suggestive paper by Dr. Hutchinson, published in the Transactions of the Medico-Chirurgical Society for 1846, the accurate author remarks on the imperfect data which have hitherto been afforded for ascertaining this point. He says, "So scanty is our knowledge upon human statistics, that it is very difficult to say what is a man's proper weight," and, no doubt it is so, to satisfy the requirements of a physiologist or statistician. But still there is a degree of knowledge, very far from perfect or accurate, on which we are in the habit of acting in the daily concerns of life, and which, as long as we continue to bear its deficiencies in mind, and are ready to correct them when the opportunity offers, is really as valuable to us as mathematical certainty. "It is impossible," as Dr. Hutchinson remarks, "to say where the weight by excess commences: it is therefore only in the extremes of weight that we can positively say that there is excess or deficiency." But it is with these extremes that we are now concerned, for it is in extremes only that disease consists, and with the slight variations from what as physiologists we lay down as the normal condition, our interference is not required.

I put, therefore, a higher value than the modest author does upon a table which he gives in that paper of average weights in proportion to height, and think that our practical deductions would not be affected by the difference, if the average were taken from all the adult males in the United Kingdom, instead of the 3000 cases he has collected. For an average, however large, must never be taken for more than it is worth, and should be rather a guide to knowledge than knowledge itself.

Dr. Hutchinson's table gives, as I have said, the mean weight, at various heights, of 5000 healthy men, but he thinks it better for practical purposes to exclude the extremes of stature, and in a broad-sheet for the use of insurance offices has inserted another table, of which he has kindly furnished me with a copy. In this the heights of men, between 5 and 6 feet only, are collected to the number of 2650, and that is the one I shall take as the standard of mean healthy weight. The table is as follows:—

HEIGHT.			WEIGHT.	
Feet.	In.		Stones.	lbs.
5	1	. . . .	8	8
5	2	. . . .	9	0
5	3	. . . .	9	7
5	4	. . . .	9	13
5	5	. . . .	10	2
5	6	. . . .	10	5
5	7	. . . .	10	8
5	8	. . . .	11	1
5	9	. . . .	11	8
5	10	. . . .	12	1
5	11	. . . .	12	6
6	0	. . . .	12	10

The individuals on whom these observations were made were men in the prime of vigorous life, capable of and accustomed to use great muscular exertions, such as sailors, firemen, policemen, Grenadier guards, watermen, cricketers, gentlemen, Oxford and Cambridge rowers, and the like: a certain quantum of paupers and artizans may be fairly set off by an equivalent allowance of draymen, wrestlers, and pugilists, who are inserted.

But a deviation to a considerable amount from this standard is consistent not only with health, but with perfect symmetry of form; of symmetry, that is to say, perfect in respect to the uses for which the form is designed. I think I cannot illustrate this point better than by taking as examples some well-known statues of acknowledged good proportions, calculating what living men thus formed would weigh, and comparing the numbers so obtained with our table of real averages. It will be seen that men proportioned similarly to some of these models of manly strength and health, would be some lighter and some much heavier than the average, and as the forms of these never dying triumphs of Art are as familiar to us as household words, we shall have set before our minds a clear and picturesque idea of the excesses of lightness and weight which are consistent with vigour. If we hear of these excesses in conjunction with the peculiar circumstances purported to be represented in the statue, we shall consider them normal; but if they exist without these circumstances, or joined with opposite ones, we may view them as indicative of an unnatural condition. For example, if we find a prize-fighter of 5 feet 9 inches weighing 13 stones, which is what the Theseus of the British Museum would weigh were he made of flesh and blood, we shall have no suspicions of his activity and health, for we know that great muscles and bones may be the cause; but should a man of letters, or one we know to be weak, weigh as much,—still more, if he should equal the Farnese Hercules, and be upwards of 16 stones,—we can take it for granted at once that fat and not muscle is in excess. So also in the case of lightness, no alarm need be felt if a man weighs as much as the Bronze Tumbler, a figure constructed to exemplify extreme activity without strength. Indeed, he may be much lighter and more spare than that statue, or any that could be selected for illustration; for the want of grace which a spareness by no means inconsistent with health induces in the human form, has prevented sculptors from giving us examples of it.

The calculations of what the statues would weigh if they were of any fixed stature, was made by the ingenious Mr. Brent, and in a way simple and comprehensible enough. He immersed in a bath accurate copies of them, and found what quantity of water was displaced. He thus obtained the weight in water of the statue at one height. The weights of the other heights were easily arrived at by the common geometrical formula, that "the bulk of symmetrical bodies is as the cube of any of the diameters." The specific gravity of ordinary water and that of the human body, alive and with its hollow organs filled with air, is as nearly as possible the same, so that the calculated weight of water represented what a living man of that bulk would weigh. To this $\frac{1}{17}$th is added to allow for clothes, which we are accustomed to include in weighing ourselves, and the comparison between the statues and their prototypes is complete. Thus, if a figure 61 inches high weighs 5 stones 6 lbs. (or 90 lbs.), it would, if 62 inches high, weigh

	Stones.	lbs.
$\left(\frac{62}{61}\right)^3 \times 90 = 90{\cdot}049$, &c. =	6	10½ nearly.

Add $\frac{1}{17}$th for clothes and disregarding decimals, we get the numbers below,

Stones.	lbs.		Stones.	lbs.
6	6	$+ \frac{1}{17} =$	6	11
6	10½	$+ \frac{1}{17} =$	7	3

and so on, through the whole of the subjoined table, which I will call the Table of WEIGHTS OF HEALTH.

Weights of Health in several Proportions.

Height.		Bronze Tumbler.		Mean Weight from 2650 Healthy Men.		Dying Gladiator.		Theseus, Brit. Museum.		Bronze Hercules, Brit. Museum.		Farnese Hercules (reduced).	
ft.	in.	st.	lbs.	st.	lbs.	st.	lbs.	st.	lbs.	st.	lbs.	st.	lbs.
5	1	6	11	8	8	8	7	9	2	9	7	11	4
5	2	7	3	9	0	8	12	9	8	10	10	11	12
5	3	7	8	9	7	9	4	10	0	11	4	12	7
5	4	7	13	9	13	9	11	10	7	11	10	12	12
5	5	8	4	10	2	10	2	11	1	12	4	13	9
5	6	8	10	10	5	10	9	11	8	12	12	14	5
5	7	9	1	10	8	11	3	12	1	13	7	15	0
5	8	9	6	11	1	11	10	12	10	14	1	15	9
5	9	9	12	11	8	12	2	13	2	14	11	16	5
5	10	10	5	12	1	12	11	13	11	15	5	17	0
5	11	10	11	12	6	13	4	14	6	15	13	17	11
6	0	11	4	12	10	14	0	15	0	16	10	18	7

N.B. In this table, where fractions of pounds have occurred in the totals, the nearest whole number has been taken.

Of the statues here selected the Bronze Tumbler may be taken as the type of extreme lightness and activity, the Dying Gladiator of robust strength; between them comes the mean weight of strong men from Dr. Hutchinson's observations. Next we have in the Theseus, and the smaller Hercules, the sculptor's idea of a hero, where the attribute of bodily strength must be equal to that of any possible man, but must not detract from grace and intellectual dignity.

For contemplation he, and valour formed.

The Farnese Hercules* exhibits a development of muscle greater than is ever known to exist in the human species. It is the embodiment of pure abstract strength, "vast, unwieldy, burdensome," represented by a massiveness of body which would on mechanical principles be an impediment to easy motions. The nearest approach to it which I have heard of, as attained by muscular development without awkward and inconvenient obesity, is in the instance of Parkins, the famous Cornish wrestler, whose ordinary weight in his clothes was sixteen stone, eleven pounds, his height being six feet. The weights of some of the most renowned heavy pugilists is considerably less than this, if their stature be taken into account. I will give, by way of example, a few instances, which the kindness of Mr. Brent enables me to quote.

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* The Farnese Hercules is a colossal statue, and its upper quarters are therefore exaggerated by the artist to allow for the distance at which they are beheld by the spectator. But this is taken into consideration in the above table, and the proportions given which the figure would have had if of the ordinary stature.

		ft.	in.		st.	lbs.
Perrins,	whose height was	6	2	weighed	17	0
Caunt	" " "	ditto		"	14	7
Spring (champion)	"	5	11	"	13	3
Jackson (champion)	"	ditto		"	14	0
Bendigo	" " "	5	9	"	12	0
Johnson (champion)		5	8	"	13	5
Slack (champion)	"	ditto		"	13	10
Mendoza	" "	5	7	"	12	4

Compare these examples of muscle and bone nurtured by artificial means to their extreme, with the weight which is added by the development of adipose tissue even in a degree not to interfere immediately with the ordinary duties of life. The difference is very striking, and we shall quickly come to the conclusion, that healthy muscle and bone, and a due amount of fat, can never add so much to a man's bulk as to simulate the weights of obesity, or cause any doubt in our minds as to what tissue excess is attributable.

Thus the mean height of 36 obese persons,* whose cases will shortly be referred to, is five feet six inches, and their mean weight 18 stones 1 lb.; being more than double that of the Bronze Tumbler, and exceeding the Theseus by half his weight. And if we judge the point not by an average, but by individual instances, a reference to the table will show the same to be true of each one as of all united.

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* See the table of Obese Persons. Of the 38 cases there recorded, the first is omitted because a child, and the 36th because his height is not known.

The *manner* of the alteration in weight will often give useful information. A sudden and great increase above what is healthy, is worse than a gradual one, because it is most probably due to some organic or constitutional change, which is difficult to obviate, whereas a progressive augmentation is very likely owing to some habits of excess which are capable of improvement.

On the other hand, a gradual *loss* of weight is a bad symptom, for it probably depends on a deep ingrained chronic cause, and is most generally, from the frequency of the disease, to be set down to pulmonary consumption : while *sudden* losses of weight, though of course always to be inquired into, may be owing to many transitory affections, which will not shorten the duration of life.

We must be prepared, however, to find in many individuals occasional variations of weight in both directions without obvious cause, and must allow for their occurrence within the limits of health. Thus most persons are heavier in winter than in summer, and with some the change takes place with great regularity. A medical man of my acquaintance, who has weighed himself for some years with strict attention, finds that at the beginning of May he commences losing weight, and falls down nine pounds from his ordinary average. He remains light till the 1st of September, and then he begins to increase till he has returned to his ordinary bulk, which he retains till the next May again reduces him. He had resolved, several summers, to give up his profession, till he found that the emaciation was due to the season, and not to real ill-health.

This loss in summer and gain in winter is curiously coincident with a fact which bare superficial theory would not have taught us to expect—viz., that the carbonic acid passing away by the lungs is greater in the cold than the warm season; that is, that carbon passes off by the respiration in greatest abundance at the same time that it is also fixed in largest proportion in the body. Our present knowledge of physiology does not enable us to account for this; and we can only conjecture that in winter, fat, and foods which make fat, are taken into the blood more copiously than at other seasons. We may expect much valuable knowledge on the subject of the quantities of carbon and other substances expired under various circumstances, when the course of experiments began by M. Regnault, and interrupted by the

French revolution of 1848, shall be again resumed.*

The loss and gain of weight will observe sometimes a shorter periodicity. It will keep the same time as the uterus, and up to a certain day in each month a man will increase, and immediately after the period is passed will decrease again to the extent of some pounds. This was the case with a diabetic patient recently in St. George's Hospital, under the care of Dr. Nairne. The 24th of each month was his heaviest day, after which he declined till the first week in the next month, when he began to augment again, till, on the 24th, he attained the maximum as before. This variation was quite independent of treatment, and was observed not only during the time he was in the hospital, but by the patient himself, who was a very intelligent man, before admission. I do not at all suppose that it had any connexion with the disease he laboured under, but rather that it was a peculiarity of the individual, which we should find to be more common, could the same frequent observations be obtained.

Though not noticed in our works on physiology, the aphorism of Sanctorius is probably true, that " even those men who are in a perfect state of health, and observe the utmost moderation in living, *once a month* increase beyond their usual weight, and at the month's end return again to their usual standard in the same manner as women do." * Mr. Addison has made himself merry with this observation of the simple-minded Paduan professor, when he makes a valetudinarian write—" In my greatest excesses, I do not transgress more than half a pound, which, for my health's sake, I do the first Monday in every month."† The satirist attributes the methodic madness of this *malade imaginaire* to his having perused the discourse of Sanctorius above quoted, and tried to act up to its precepts. The obscurity into which the old physiologist falls, when he lays hold on his systematic helps, and endeavours to give reasons for what he had seen, has prevented many from appreciating the pains-taking accuracy of his matters of fact. Whatever we may think of his theory, these are most valuable, and we must be very cautious before we question on variations of weight the authority of a man who, like Sanctorius, lived in a balance.

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* See Annales de Chimie, T. xxvi. p. 519.

I would not have said so much on this subject had it not a practical bearing. But the observation is of importance, to remind us not to attribute to remedies an increase in weight till we have observed whether or not it be natural and periodic, and to teach us, on the other hand, not to despair at our patients losing a few pounds under a treatment otherwise beneficial, till we see that they do not regain it after a certain interval.

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* Sanctorius, Aphor. lxv.

† Spectator, No. 25.

CHAPTER VII.

Account of the "Table of Cases of Obese Persons." History of obesity as it occurs in infancy, youth, adult age, middle age, and declining years, with some of the immediate inconveniences it gives rise to. Fatty tumors. Their anatomical characters, and deductions therefrom.

BEFORE I pass on to the pathology of true fatty hypertrophy, or the history of obesity, it will be right to give some general account of the Table of Cases from which my deductions are drawn. They are in all 38; four of which were communicated to me by Dr. C. M. Babington, seven by Dr. Shearman of Rotherham, and one by Mr. Turner of Manchester, and for the remaining twenty-six I am myself responsible. Since it has become known that my attention was directed to the subject, I might have added many more to my list, but the details of those brought before my notice were so precisely similar to what I had already collected, that I thought to cite them would be merely to make a parade of statistical accuracy without really rendering the information afforded more exact. I have selected, principally, instances of persons still alive, and in moderate health, partly to render the consideration of the subject more simple, and partly that I might obtain from them fresh information as I went on with my researches. Should any among them be my present readers, and recognize themselves under the disguise of initials, I here beg to offer them my best thanks for the freedom with which they have communicated the particulars of their cases, and answered the inquiries I have made. In some instances several weights and several ages are assigned to the same individual; here the first age refers to the first weight, the second age to the second weight, and so on. Thus, M. H. (No. 4) was, at thirteen years old, 13 stone; at twenty-five, 15st. 3lbs., J. R. (No. 7.) was at sixty-two, 23 stone; four years later, at sixty-six, 17 stone, &c.

The order in which they are placed is that of the period of life at which obesity commenced; which seemed a natural arrangement of the subject, on account of the differences which it presents in accordance with that circumstance. The headings of the several columns of facts speak for themselves, and will be referred to in the succeeding pages. They could hardly have been less numerous without diminishing the interest of the Table, but all typographical care is taken to render the long line as easy as possible to follow with the eye without confusion.

A reference to this record of experience will show that obesity may commence at any stage of life, but that the symptoms which accompany it, and its usual causes, are different at the different periods.

It sometimes begins immediately after birth, and proceeds rapidly, as part of a general hypertrophic tendency affecting the whole body. The children come into the world very fat and strong, and grow very rapidly, so that at two or three years old they are as large as others at seven or eight, and are often at this stage made objects of curiosity at fairs and elsewhere.

The evolution, however, of the whole person does not continue equable; the belly becomes large, and the limbs are often proportionate; but the chest remains contracted, the lungs apparently being undeveloped. The genital organs are often those of an infant, while the whole body almost equals the adult bulk. This congenital monstrosity is said by Dr. Jäger to be more usual in the female sex in Germany, and in the male in France and England,* but happily it is not sufficiently common for any statistics on the point to be obtained. There is every probability of these poor creatures dying of suffocation in early childhood, and if they escape that they are usually carried off by dropsy about the age of puberty.

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* Vergleichung einiger durch Fettigkeit oder Colossale Bildung auzgezlichneter Kinder von Dr. G. F. Jäger. Stuttgart.

One of these children was born in humble life, at Manchester, about three years ago. It was exhibited at six months old, at which time it weighed ninety pounds. What has since become of the poor infant I have been unable to learn. The only noticeable point about it was that the chest was small in proportion to the body. Another (No. 1 in the Table of Obese Persons) was also born at Manchester, in a higher station of life, being the seventh child of a medical man. It was, as you may see, born very large, and shortly before its death weighed eighty-seven pounds. At one year old he weighed forty pounds, and was thirty-one inches in height. The circumference of the head was twenty-one inches; of the thigh, seventeen and a half; of the ankle, eight inches. This child was introduced, through Sir James Clark, to Her Majesty, who was pleased to express her surprise at the ease with which it could walk. An interesting point about this case was, that, contrary to what is usually observed, the mental faculties were developed in an equal degree with the corporeal bulk, the understanding being very precocious. An early death, as is ordinarily the case, removed this child from further observation.

A minor degree of obesity is sometimes inconvenient to babies at the breast, which vanishes soon after weaning, or at least after the second year. This appears to depend solely on an excess of over-nourishing food, and is under the control of a better regulated diet. And it is very desirable that such a system should be adopted, for in spite of the pride which mothers take in this condition of their offspring, it certainly renders them less able to bear the acute disorders incidental to their age.

Infantile obesity is not more common in the families of corpulent persons than in others. None of those mentioned in the Table had found it occur in their progeny, nor can I hear that children so affected have in general fat parents.

The form, however, which affects the succeeding period of life, is almost always due to hereditary disposition. Those who get fat between the age of infancy and puberty have usually several corpulent relations, and themselves attribute their size to this source.

But this is not of itself sufficient, for on inquiry there is most commonly found some exciting cause, as well as the predisposing one of family tendency. In the five cases before us (Nos. 2, 3, 4, 5, and 6), the exciting cause was, in two, doubtful; in two, scarlatina; in another, some other form of acute fever. In a boy of preternatural fatness, who was shown, some years ago, by Mr. Pettigrew, at the Royal Institution, it was the confinement consequent on a fractured limb. The corpulence of J. R. (No. 7) dates from an injury to the spine shortly before puberty, and I have traced the same kind of cause in several other cases, which, for want of sufficiently accurate details, and other reasons, I have not tabulated.

It would appear that the active minds and perpetual bodily motion of children restrain a natural disposition to form fat in excess, and that when from illness these are intermitted, the diathesis developes itself. But besides this, the impression made by the illness on the vital functions seems to have the effect of hurrying them forward, so that the whole bodily structure, as well as the adipose tissue, is rapidly perfected in these cases. Obese girls often menstruate at an unusually early age; Mrs. S. (No. 6) did so at nine, and at eleven says she was as perfect a woman in all respects as most females at nineteen; E. L. (No. 5) at twelve; H. W. (No. 20) at thirteen; Mrs. Q. (No. 24) at twelve.

I think I have observed in families where there is a tendency to corpulency, that those members of them in whom the hereditary disease is likely to be developed, are distinguished by this precocity of body, and that those in whom it is not found have a better chance of escaping the unfortunate entail. If further observation confirms this idea, it will afford a useful means of prognosis, and teach us when to be on our guard against future obesity, and when we may feel at ease on that point. It is not a mere matter of curiosity or overcautious prying into the future; for I firmly believe, that well-advised habits of living, and measures such as rational physiology will suggest, may in many cases prevent this bane of comfort and shortener of life, and in all much diminish its intensity. It may tend as caution also in our treatment of the acute diseases of young persons, lest in healing one disorder we give occasion to another, which will stick by them for life.

Shortly after puberty, there is, in the female sex, a tendency to a temporary increase of roundness in the form, but it hardly attains to what may be called corpulence, and instances of great size do not generally date their disease from this period. There are, however, four cases recorded in the Table before us (Nos. 8, 9, 10, 11), but they strike me as exceptional. By far the most common age is that between eighteen and thirty, of which twenty-one cases appear in the list. In fact, at this, the active period of life, the circumstances which induce obesity are apt to occur. Occupations are undertaken which involve a change of habits likely to bring forward the previous disposition; a man becomes a coachman, a cellarman, a messman, is salivated, and so on, as we see in the Table, and obesity follows. Where the tendency is strong, he is not likely to escape without it over the age mentioned. It is at this time, too, that marriage is commonly contracted, to which in three cases, (Nos. 14, 15, 16,) the supervention of corpulence is assigned, while in two more the birth of a first child appears as a proximate cause (Nos. 17 and 23).

Has not the greater deposition of fat in the subcutaneous tissue of woman some connection with the facts before quoted from MM. Andral and Gavarret, about their deficient excretion of carbon by the lungs? It continues during the whole period that the uterine functions are vigorous, and so does the deficient excretion of carbon. And when carbonic acid is again exhaled in a proportion equal to the male subject, and the catamenia cease, that harmonious rotundity so justly sought after by the artist, that plumpness which the "elegans formarum spectator" appreciates, is lost; the subcutaneous fat either diminishes, so that the figure becomes angular and wrinkled, or it increases irregularly, and in a morbid manner, so as to constitute an unnatural state—corpulence.

Irregular and partial obesity is very apt to occur at about the age of the cessation of the functions of the generative organs, and then often assumes an asthenic form. It affects the omentum more commonly than the subcutaneous tissue, and constitutes the prominent abdomen so frequent at this age.

It is certainly the most common form, though its frequency would not at all appear from the Table of Cases. The fact is, that it is so common that I have got but few detailed notes of its occurrence, and persons otherwise healthy are so apt to take it as a matter of course, that they do not consult a physician on the subject. But it must not be supposed that it is a matter of little moment; I believe it to be a great shortener of existence by the diseases to which it gives rise; and the daily amount of petty inconvenience traceable to it would often be willingly exchanged by the sufferer for actual pain. The dragging weight of the abdominal fat dilates the fasciæ of the parietes, the muscles become unequal to the additional burden, and sometimes give way, forming ruptures. The intestines having more space than they require, and losing the bracing effect of the muscular pressure, are displaced, dilated, and liable to accumulate air in excess. Then arise constipation and congestion of the portal system, leading to piles and diseases of the liver, and by the disturbance of the general circulation to dilatation of the heart, apoplexy, and asthmatic diseases depending on congested lungs.

It is at this period, also, that the most important form of partial deposition of fat occurs—that, namely, on the muscular structure of the heart. This happens sometimes in persons not otherwise disposed to the abnormal formation of adipose tissue, but is very much more usual in those who have that tendency. For example, at St. George's Hospital, from January 1, 1845, to January 1, 1850, the hearts of thirty-six corpulent persons were examined, and in twelve of these was noticed such an amount of fat about the base of the heart as to constitute a deformity of the organ. In 165 bodies not remarkable for fat, opened during the same time, where disease of the heart was a feature of the case, there were only four in which the quantity of fat was notably increased.* The difference between the two classes is sufficiently remarkable to render of no account the smallness of the numbers from which the statistical deduction is drawn. The very great danger which corpulent people run of becoming the subjects of this affection is rendered by this observation very clear, as also the small chance there is of its being found in others—deductions which have a practical bearing on both diagnosis and treatment.

The tendency to the partial distribution of fat which has been noticed to be so frequent at the turn of life, increases with increasing years. It is rare however to find this diathesis coincident with extreme old age, the inconveniences which it gives rise to being usually fatal before that time. I have had occasion, during the last few years, to see, on behalf of the Hand-in-Hand Insurance, a great number of aged persons, from eighty to ninety-three years old, who were desirous of insuring their lives until January, 1850, for the sake of securing the amount of a bonus then to be declared by the Equitable. Among these there were but two obese persons, and both of these are since deceased.

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* See the accurately kept register in the Museum of the Hospital.

Those who attain great age are generally very thin and spare, but still the fat about the heart is increased in quantity, and there is a good allowance of it in the mesentery. The omentum, however, does not grow, so that a prominent abdomen is as uncommon among nonagenarians as it is in youth. In the dissection of John Bayle,* the Northamptonshire button-maker, who died at the age of 130, and had constantly frequented the markets till within twelve years of his death, it was remarked that there was scarcely any fat about the body or omentum, though the mesentery and heart, like that of the famous sesquicentenarian Parr,† were well supplied with it.

Fatty tumors appear fairly entitled to the name of partial fatty hypertrophy. They consist of a pure repetition of the normal adipose tissue formed of spherical fat vesicles, among which some appear nucleated, and others not; while others, which may be conjectured to be in a state of atrophy or chemical change, exhibit a separation of the constituents of fat from one another such as is produced in fat which has began to decompose. The margarin, or margaric acid, forms stellated radiated collections of crystals to all appearance outside the vesicle's wall; such as may be seen in the fatty matter formed in other tumors.*

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* See a paper by Dr. James Keil, in the Philosophical Transactions, for 1706, vol. xxv.

† Harvey's Works.—Dissection of Parr.

Fatty tumor, or Lipoma, is developed in the subcutaneous areolar tissue, most usually in places where fat in the normal condition is most abundant,—as on the breech, the shoulders, the back, the neck, the cheek; but still it is also found in situations nearly destitute of adipose tissue; as, for instance, on the hairy scalp. Sometimes, also, it may be seen under the mucous membranes, as in the submucous cellular tissue of the intestines; and in the outside of the serous sacs, as in the case of the pleura, where lappets of fat may be sometimes seen bordering the lungs, and hanging into the free sac; also under the synovial membranes, as in the knee-joint, forming what Müller calls *Lipoma arborescens.*

These tumors, being allowed on all hands to be non-malignant, appear to be dependent on some local state of the areolar tissue in which they are situated; but what that local state is, the microscope fails to teach us, as it differs in no wise from the healthy condition of the part.

They are certainly more common in corpulent than in spare persons, and seem therefore to depend on the same causes which give rise to general or other kinds of partial obesity. They are also in some degree amenable to the same constitutional treatment.

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* Rokitansky, Path. Anat. I. 282.

Though non-malignant in their nature, they may become so from injuries or ill-management, and moreover are exceedingly inconvenient from their size and shape. This makes it so desirable to remove them as speedily as possible. Where that can be done with ease and safety by the knife, it is no doubt the readiest and surest method of accomplishing the object; but when impediments occur, from the situation of the tumor, from the natural frame of mind or body of the patient, and where time is no object, I think constitutional remedies should have first a fair trial. If not capable of entirely removing it, they will cause such a diminution as to render the operation much less formidable and hazardous.

CHAPTER VIII.

Predisposing causes of obesity—form of body, external and internal; hereditary nature; influence on fertility. Exciting causes of obesity—acute fevers; surgical injuries; occupations; states of mind.

I HAVE already alluded to one circumstance in the constitution of those who are liable to become obese, which may be made use of in our prognosis of that malady, namely, the precocity of corporeal frame, exhibited especially in the female sex by early maturity of the reproductive powers. I shall now resume the subject of the forms and habits of body which are found in these individuals as being in fact the *predisposing causes* of the disease.

These predisposing causes are of more importance in this than in any other morbid state, for they have certainly more influence over its production than the accidental. In those who are so constituted as to have a tendency to this form of hypertrophy, the most careful treatment will often not suffice to keep it off; while those who have an opposite diathesis remain thin, let them live as they will.

In persons prone to obesity, we may usually observe, that the bony framework of the body is less massive than in the spare, as is indicated by the smallness of their hands and feet. In the great majority of the cases before us, this peculiarity has been noticed in the column appropriated to it. The same is commonly seen also in cattle; in buying beasts likely to fatten well, the grazier will select those whose legs below the knee are short and taper, and refuse the long-backed, heavy-hoofed ox. This shows that bone has had little to do with the great weights of the obese persons recorded in the list. Their osseous skeleton, the part of their body which is of the greatest specific gravity, is smaller than that of other people, yet the whole body is much heavier. This confirms what was suggested in the former chapter, that extreme weight in the human species may be always considered as due to bulk of adipose matter, and not to excess of bone. A sufficient quantity of bone added to the body, to make a person come nearly up to any of the weight of these corpulent individuals, would render the skeleton too clumsy to answer the ordinary purposes of life. A man can move about and work with eight or nine extra stone of fat about him, as, for instance, R. B. (No. 31), who is a miller in constant employment day and night; but if that quantity of bone was laid on his skeleton, the muscles would be unable to wield the deformed limbs. The weight of a man's bones, in the dry state, with the ligaments attached, does not exceed a stone at most, and it is easy to guess how its relation to the muscles would be altered were it quadrupled in size only.

In persons of hereditary obesity the skin is usually fresh coloured and dry; the hair soft and fine.

In the urinary organs I am not aware that they differ in any respect from others.

In youth and middle age the digestive apparatus performs its task usually with rapidity; and in cases where fatty hypertrophy is general throughout the body, I have not observed that tendency to constipation which is sometimes said to accompany obesity. The action of the bowels is generally natural, and in some cases loose. But where the accumulation of fat is principally in the omentum, that pendulous state of abdomen is apt to be produced, which, causing a displacement and dilatation of the bowels, makes those, which were naturally loose and active, sluggish or irregular.

The respiratory function in obese people presents us with a well-marked and very universal peculiarity. The volume of air which these people are capable of containing in or expiring from their chest is considerably less than the average quantity of those of their height. The lungs, instead of holding more air because the body is larger, appear, in these cases, of diminished capacity. Thus the "vital capacity" of H. T. (No. 35), a man of enormous muscular strength, and in his youth remarkable for his power of wind, ought to have been at least 250 cubic inches; instead of that, it is but 205. Ch. S. (No. 9) held 120 cubic inches of air, whereas she ought to have contained 206, according to the table of averages published by Dr. Hutchinson. G. O. B. (No. 18), when in perfect health, five years ago, held 255, instead of 270 cubic inches. He holds now very much less, probably from congestion of the pulmonary tissue, and increased corpulence.

To what are we to attribute this diminished capacity for containing air in the chest? Is it from the actual area of the thoracic cavity being less in corpulent persons? Dr. Hutchinson cannot find that it is so. He has kindly lent me for exhibition in our Theatre two casts; the one is from the interior of the chest of a stout man, standing 5ft. 7in. and weighing 11st. 3lbs.; the other is the cast from the interior of the chest of a muscular light man, dead in the prime of youth and health (in fact, the notorious Hocker), who was 5ft. 10in. high, and weighed 9st. 7lbs. The superficial inches of the walls of the chest inside are, in the stout man, 318; in the spare one, one-third less, 219 only. The spare man, though taller, had, then, a smaller chest than the corpulent. But was this actual capacity represented by the vital capacity? Was the stout man, who had the largest chest, as well as the most bulky body, able to breathe most air? No. The vital capacity of the large chest of the stout man was 202 cubic inches; the vital capacity of the small chest of the spare man 233 cubic inches.

Dr. Hutchinson lays this diminished vital capacity to the motion of the ribs being impeded by the accumulation of fat outside them, but I am disposed not to attribute quite so much to this impediment as he does. With a view of testing how far it exists, I was anxious to obtain some accurate observations on the movements of the ribs, to which the ingenious instrument invented by Dr. Sibson affords facilities. With the kind assistance of that gentleman I have got notes of the movements of the various parts concerned in respiration in the cases of H. T. (No. 35), Ch. S. (No. 9), and G. Wn. (No. 22). Our first observations tended to confirm most strongly the suggestion that the movements of the ribs and diaphragm were much impeded by the accumulation of fat. For example, in ordinary respiration, in H. T., the movement of the tenth rib, which should be $\frac{1}{10}$ of an inch, was only $\frac{2}{100}$; the movement of the sides of the abdomen, which should be $\frac{9}{100}$, was only $\frac{3}{100}$. In G. Wn. the movement of the tenth rib, which should be $\frac{1}{10}$, was only $\frac{2}{100}$, the movement of the sides of the abdomen $\frac{4}{100}$. The movement of the centre of the abdomen, which should be $\frac{30}{100}$, was in H. T. only $\frac{12 \text{ to } 16}{100}$, in G. Wn. $\frac{15 \text{ to } 20}{100}$

The movements, however, of forced respiration presented different results; being, in fact, in the centre of the abdomen, which is raised by the diaphragm, greater than usual, amounting to an inch and a half instead of an inch.

These were the results obtained by applying the instrument to the skin in the usual way. But when we take into consideration the yielding nature of the medium through which the motion of the rib has to be transmitted, it is obvious that this method of observation, though correct with ordinary individuals, will not yield a satisfactory result in the case of the obese. There may be a considerable motion of the ribs, which is yet imperceptible on the external surface. And so, indeed, we found it; for when Dr. Sibson pressed his finger tightly on to the rib, so as to displace the fat, the movement of the instrument applied to the finger indicated that the play of the thoracic walls was nearly, if not quite, equal to that found in ordinary individuals.

For instance, in G. Wn., the right side of the abdomen, which had moved but $\frac{3}{100}$ instead of $\frac{8}{100}$ without pressure, moved, when the finger was applied, $\frac{10 \text{ to } 12}{100}$, or more than usual; the tenth rib moved $\frac{8}{100}$ in fact, when before it had appeared to be moved only $\frac{2}{100}$. The ribs appeared to move freely underneath the fat.

We have, I think, a right to conclude, from these observations, that the slight movement of the external surface of the chest in fat persons, as observed by the eye, or by the hand lightly laid upon it, is not so much an indication of diminished mobility of the bones within, as appears at first sight. I am disposed to think that the motion of the diaphragm in forced breathing is equal, if not greater, in them than others; but that the upper ribs in ordinary and also in forced breathing move somewhat less than usual, but not to the extent indicated by the external surface.

The importance of these observations consists in their application to diagnosis. They lead us to be cautious in our examination of the chests of corpulent persons, and bid us not to jump to the conclusion that there is pulmonary disease, simply because there is diminished vital capacity or diminished movement apparent to the eye.

I was anxious to put in consecutive order all the facts I have to lay before you about the lungs of corpulent persons, and therefore I have postponed to this point what might have been introduced, when showing, by reference to the examples afforded in the casts belonging to Dr. Hutchinson, that the *actual size of the lungs bears little proportion* *to the height or weight of the individual.* What I wish to say now is, that anatomy quite bears out this opinion. It is seldom that an opportunity occurs of weighing the lungs of a perfectly healthy man, but healthy beasts are always open to observation in our butchers' slaughter-houses; and as the animals are always killed in the same way in London, the internal organs, when sound, appear to the eye always in the same condition as regards the blood, &c., which might affect their weight. Where we cannot ascertain a fact in the human economy by direct observation of our own species, comparative anatomy may fairly be brought into use as affording at least analogous evidence. I have thought, therefore, it might serve as some help to our investigations, and at all events would be interesting, to know what relation to the weight of the whole beast several of the viscera bear, and what also is their mutual relation in different breeds of cattle of different degrees of fatness. I have with this view obtained at several slaughter-houses the weights taken, while the carcase was being cut up, of the lungs, liver, and pancreas, and the weight of the quarters, of between seventy and eighty cattle. The result is, as I said before, that the lungs bear no relation to the weight of the quarters, or to its fattening propensities. Thus a thin, large-boned Dutch beast, whose four quarters weighed 95st., 6lbs., had lungs weighing but 9lbs. 10oz.; but a small Norfolk beast, weighing 57st. 1lb., also thin and unfatted, had 11lbs. 6oz. of lung; a Leicester, of 55st. 7lbs. had 7lbs. 8oz. of lung; small beasts, with 20 or 30 stone of fat upon them, had lungs similarly proportioned; twenty-three "improved Scotch" oxen, the quarters weighing from 100 to 104 stone each, had an average of 9½ lbs. of lung. The lungs of beasts that fatten well do not seem to be, as Professor Liebig suggests, smaller than the lungs of those that fatten ill.

The same observations on cattle, however, though they do not enable us to connect obesity with the organ last referred to, show some degree of correspondence between that condition, or a tendency to it, and another very important viscus. The size of the liver certainly seems to bear a proportion to the weight of the animal. The livers of the lean beasts first mentioned weighed only thirteen or fourteen pounds, while in the Scotch beasts they were from sixteen to twenty. In the pancreas, where I must confess I expected beforehand to have found a difference which would have connected my notices with those experiments on the rabbit which I have quoted and exhibited, no variation appeared. It weighed about a pound in all equally.

I have not put these experiments forward with the intention of speculating upon them,—we must have much more numerous, much more accurate observations, before any result can be come to; but they may perchance be the means of leading others in the same direction, for I believe it is the road to truth on other points of hereditary and constitutional tendency, as well as the one we are now specially considering. Were a balance kept in the slaughter-houses of a few respectable butchers, and breeders of cattle to get copious averages of the weights of the viscera in different breeds, I think they could not fail to learn much which would be useful to them both in the selection and management of their beasts, and the fitness of different sorts to different purposes. Still more would the physiological physician gain, for by knowing what organs are in excess or comparative excess in those whose constitution inclines to gout, scrofula, phthisis, and the other complaints evidently inherent in families, he might, before those or other organs become actually diseased, guard against the habits which lead them to be so. The plan adopted at the St. Marylebone Infirmary by Dr. Boyd and the late Dr. Clendinning,* of comparing the weights of each separate diseased organ with the weight of the whole body, has led already to some unexpected results in pathology, and we may reasonably expect as interesting information from it concerning morbid tendencies in healthy parts, when a sufficient number of cases can be collected. The method may be slow and plodding, but if we feel that by it we are approaching truth, it will not be tedious, and possibly may be the shortest in the end, for, according to the Baconian adage, "Claudus in viâ antevertit cursorem extra viam."

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* See Dr. Clendinning's Croonian Lectures for 1838, published in the Medical Gazette; and Dr. Boyd's papers in the Edinburgh Medical and Surgical Journal, vols. 55, 58, 60, 61.

Whether we shall ever arrive at an exact knowledge of what is the form and proportion of internal organs which causes obesity I know not, but whenever we do so, I think it will be by means of observations on the relations which these several viscera bear to one another in the *healthy* subject, assisted probably by comparative anatomy. All that can be deduced from what has gone before is, that their lungs are probably not smaller than those of others, but, from some unexplained cause, are not capable of containing so much air; that the upper-ribs are somewhat impeded in their motions, but the diaphragm not at all; that if our race resembles, as it probably does, cattle in the proportion of its organs, the livers of obese persons are likely to be larger than those of others, and their pancreas of the same size.

We come next to the functions of the organs of reproduction. Corpulence has been stated to diminish the fertility of the human species, and instances are quoted among the higher ranks where families with this tendency have become extinct. But this is hardly a fair argument; for it must be remembered that the upper classes are never so prolific as those below them in social position, and that every aristocracy in Europe, unless constantly recruited by new creations, would soon have none to represent it. Several of the cases before us, who are married, are by no means unfertile, and some have much exceeded the average of four to each married pair, which the registrar-general's report assigns as the number calculated to continue the increase of the population at its present rate. Two brothers and a sister, of considerable obesity (Nos. 26, 27, and 28), have twenty-six children between them, instead of the average number twelve. No. 33 has twelve children; No 35, eleven, though his wife, as well as himself, is remarkably corpulent, weighing, he tells me, nearly seventeen stone; No. 11 has had ten miscarriages; No. 15 has seven, No. 18 six, No. 23 five children.

Whatever be the form of body which predisposes to obesity, whether what has been here suggested, or any other more hidden conformation, concerned with more mysterious functions, there is no question about the fact, that it is handed down from parent to offspring in a more marked degree than any other disease. Thus, while thirteen per cent. is the full proportion of insane patients whose disease can be traced to the preceding generation, and twenty-four and a half per cent. the number of consumptive persons in whom the affection is hereditary,* we shall see, by looking at the table of corpulent persons, that their tendency is referable to their ancestors in twenty out of the thirty-eight cases quoted, in five more is to be seen in their collateral relations, in six only is stated to be absent, and in the rest is doubtful or not known.

This hereditary nature of corpulence, rather I think than any peculiarity of climate, has made it endemic in several countries. It appears to hold more to the race than to the land they live in. Our own nation has long been known for its tendency. Erasmus says, that in his day for one stout person to be seen on the Continent there were four in England, and I do not think that our inclination in this direction has in any degree diminished. I have sometimes, when detained by accident in one of our great London thoroughfares, counted for ten minutes or more the multitudes which streamed past. I have rarely numbered one hundred adults without a passer-by whose mode of walking was decidedly hampered by obesity, and occasionally as many as two and three per cent. went by. Among the pure Celts who live in the same climate as we do, it is less frequent. It has been diminished in our Transatlantic brethren, probably by the more general mixture of blood by intermarriage.

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* See First Report of the Hospital for Consumption, p. 19.

In China there is every variety of climate, food, and social condition, yet Mr. Finlayson remarks, "*The whole race* displays a remarkable tendency to obesity. The nutritious juices of the body are directed towards the surface, distending and overloading the cellular tissues with an inordinate quantity of fat."* This general tendency of the whole people can only be attributed to the hereditary diathesis, unchecked by intermarriage with others differently constituted. It is an evil which the exclusiveness of that singular people has entailed upon them.

Of the *exciting causes* of obesity in those disposed to it, none appears so common as the occurrence of an acute attack of illness. This was the case in eight of the instances quoted in the table before us, where we find scarlatina (in two persons), "a fever," gonorrhœa, childbirth, erysipelas, "an illness," syphilis, quoted as the causes of the sudden increase of fat. The confinement rendered necessary by the disorder has probably a great share in the obesity consequent on it, but the complete change in the nutrition of the whole body which an acute fever gives rise to must not be overlooked. A full examination of what we know of this change of nutrition in fever, and its peculiar connection with adipose matter, will more properly come under our consideration when we arrive at the subject of Emaciation. At present it will be enough merely to allude to the loss of fat which accompanies or even *precedes* the change of temperature in febrile heat, and to remark that when that febrile heat declines, there is a natural disposition to regain fat, and in those patients who have a tendency to obesity, the secretion is apt to accumulate in excess.

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* Finlayson's Embassy to Siam and Hue, p. 229.

Accidental surgical injuries are not an infrequent cause. This happened, as before mentioned, to the boy exhibited by Mr. Pettigrew at the Royal Institution, whose obesity was atributed to a fractured limb, and to J. R. (No. 7). A case was also related to me a few days ago by a non-professional gentleman, who had the misfortune, some years since, to be thrown out of a tandem in company with a friend. Both were severely hurt, but the worst part of the consequences happened to the latter, who began from that time to be obese, and has never since recovered.

An analogous cause is chronic disease, which makes confinement necessary without injuring the constitution. Dr. Wilson related to me the case of a gentleman laid up with chronic rheumatism, who has become so unwieldy, that he is obliged to have a machine constructed to raise him in his bed; and instances of the same thing, though not so striking, will probably suggest themselves to every medical man.

Taking a large quantity of liquid of any description is not an unfrequent cause of corpulence. Those who are copious water-drinkers seem to suffer as much as the intemperate, and there are few obese persons who are not inclined to thirst. See Cases 30 and 31, in whom this was notably observed, and in others I have reason to suspect the cause, though a confession of the fact, concerning which they are inexplicably touchy, could not be elicited.

No. 13 (E. L. A.) may recall to our minds the observations of Mr. Morton on sheep, where defective light was found to add so much to the fattening powers of moderate diet. He was employed in the cellars of a brewery, and, though strictly temperate, found his bulk becoming so great as to give him much alarm. He obtained a situation as clerk in the same establishment, and found the employment above ground cause a rapid reduction. He has since become a collecting clerk, and is diminished still more.

It would be expected that want of sunlight would have a similar effect upon colliers, but I cannot find that it does so: probably their severe labour, and the activity of their skin, from working naked, and frequent washing, may counteract the influence of darkness. A useful suggestion from this conjecture may be afforded to us in our treatment, the practice of which will shortly be alluded to.

These, and a variety of similar circumstances, under which obesity is apt to occur, may in fact be brought under the same common expression before laid down, that *fat is formed where the materials are digested in greater quantity than is necessary to supply carbon to the respiration.* But to cite more of these circumstances would be an unnecessary consumption of time, and would render this chapter rather a collection of interesting anecdotes than a scientific deduction.

CHAPTER IX.

Anatomical characters of obesity. The manner in which these act on the body so as to cause diseases, viz. by the circulation. This fact illustrated by post-mortem records.

THE anatomical characters of obesity are those of all true hypertrophies. There is an increase in the volume and weight of the tissue affected, but its specific gravity and its intimate structure are unchanged. The fat of obese persons does not seem to differ in its composition or form from that of the spare and healthy; always excepting those cases where disease has caused emaciation, when, as I will afterwards show, important and interesting changes take place.

Viewing the body as a whole, the most serious deviation from the standard of health is the vast increase of bulk, and the influence on the circulation, which the augmentation in number of the capillaries, arising from that bulk, must occasion. Consider what an enormous quantity of useless blood there must be in the capillaries of Mrs. S. (No. 6); her natural weight would be at most thirteen stone, while her actual weight being twenty-eight stone eight pounds, she has, in addition to that which she ought to bear, fifteen stone of fat, all as full of blood as healthy adipose tissue should be. And this is not accompanied by any proportionate increase of strength in the heart, and other powers which are to circulate this blood.

How overburthened they must be! how unequal to the task!

From the disproportion that must thence be caused between the pulmonary and systemic circulation, the former must be unequal to the aeration of so much more carbon than it was made for; the contents of the vessels are probably more venous than is right, the blood blacker, more disposed to form congestions, and less capable of recovering itself from the poison of diseases.

Hippocrates* rightly observed, that the blood-vessels visible to the naked eye are in fat people of small calibre compared with the size of the body; we who have the microscope should not neglect to add to this, that the vessels which that instrument has revealed to us are in their aggregate amount vastly increased, and we shall then easily understand the disordered balance which we find.

This condition of the circulating system should never be forgotten; it has a most important bearing on the treatment of all diseases in corpulent people, and the more acquainted we become with pathology the more will it influence our practice.

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* Hippoc. Epidem. ii. § 2 (edit. Kühn.)

The most striking way of illustrating its importance is to examine the causes of death in a considerable number of cases of this affection, and see what bearing on them the circulating organs may bear. With this intention I have put together 69, of which the *post-mortem* records are thoroughly to be trusted; 67 having been examined at St. George's Hospital,* and two by Dr. Shearman, of Rotherham, a gentleman of well-known accuracy and research.

CAUSES OF DEATH IN SIXTY-NINE CORPULENT PERSONS.

Medical Cases.	
Dropsy	13
Apoplectic Coma	11
Pneumonia	5
Pleurisy (acute 2; chronic 1)	3
Fainting (fatty atrophy of heart)	1
Aneurism, 1; malignant disease, 1; fever, 1; rupture of stomach, 1; polypus uteri, 1	5
Erysipelas of face	1
Surgical Cases.	
Peritonitis after hernia	8
Erysipelas after ulcers and slight wounds	3
Gangræna senilis	2
Diffuse cellular inflammation	2
Secondary abscess	3
Nephritis after lithotripsy	1
Diseased prostate	1
Accidents	10
	69

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* See the Register Books from January 1841, to January 1850, in the Hospital Museum.

The heart was examined in fifty-seven of these patients. In seven it was found healthy—viz., in four who died from accidents, in one case of rupture of the stomach, one of hernia, and one of nephritis. In the latter case, the principal local collection of fat was about the kidneys, where the amount usually found was greatly augmented.

In fifty of the fifty-seven cases where the heart was examined, it was found diseased.

Of the fifty diseased hearts,

5 were hypertrophied and not dilated;
8 hypertrophied and dilated;
26 dilated only;
11 atrophied.

In sixteen of these there was an increased amount of vesicular fat about the heart—viz.,

In 13 of those which were dilated;
In 2 of those which were atrophied;
In 1 of those hypertrophied and dilated.

In fourteen instances the kidneys were also affected with chronic degeneration, which in all those where an opportunity occurred of forming an opinion, seemed to be consecutive on the cardiac disease.

A cursory glance over the facts recorded in these lists will be sufficient to show what a great influence over life the disorders of the circulating system have had. In the medical cases, the two classes which make up the bulk of the whole—viz., Dropsy and Coma—may be referred to this source; and in the surgical cases, nearly all are of a nature to be much aggravated by an ill-balanced distribution of blood.

The fourteen cases of degenerated kidneys may also without force be referred to a chronic congested state of vessels, than which nothing in my opinion is more frequently the cause of that disorganization which leads to hardening, deposit of oily globules, destruction of the urinary tubules, albuminous urine, urea in the blood, and dropsy.

The change which most commonly affects the heart is dilatation, probably dependent on the greatly increased quantity of capillaries distributed throughout the body, and the consequent increase in the amount and pressure of the circulating fluid upon the central organ. The hypertrophy which sometimes ensues is not unlikely to be an effort of nature to supply force in proportion to the increased demand.

In 11 cases out of the 49, atrophy of the heart was observed, that is, diminution in thickness of the walls without any external augmentation of size; and in such of these cases as were submitted to the test of microscopic examination, a deposition of *molecular* fat, destruction of the nuclei, and other evidences of degenerated muscle, were found.

We must be careful to distinguish this fatty atrophy or degeneration from deposition of *vesicular* fat; the first arises from deficient nutrition, the second is due to excess. One is a retrogression from a more highly endowed tissue to one less distinguished by its importance and offices; the other is an increased growth. It is true that they may be coincident, as in the instances before us of atrophied hearts in obese people; yea, they may exist together in the same organ, as in two of these cases, where there was much fat at the base of the great vessels and degenerated muscle at the same time. But still they are contrasted conditions, hypertrophy and atrophy of different tissues.

It still remains to be explained why these two opposite states are so often associated together; why degenerated muscle is more common in fat than in thin people, as would appear to be the case from a paper presented by Dr. Quain a short time back to the Medico-Chirurgical Society. It does not arise from the pressure upon the muscle caused by the altered shape and size of the heart; for it is equally apt to occur in cases of obesity where there is only the ordinary amount of fat at the base of the organ, as where the adipose tissue there is augmented. It more probably depends on some change in the condition of the circulating fluid associated with obesity, which renders the formation of fibrin more difficult, and allows the muscular fibre to undergo an interstitial decomposition into an oily matter.

The anomalous state of the circulation in corpulent persons, caused by the quantity of capillaries, either with or without the cardiac disease consequent thereon, is, I think, sufficient to explain all the complaints to which they are subject. The sluggishness of their blood's movement accounts for their proneness to cachectic boils, to diffuse cellular inflammation, to congestions of the lungs, liver, and brain; and explains why the use of the lancet is so hazardous in such patients.

CHAPTER X.

Treatment of Obesity. How treatment is applicable at different ages. The materials which form fat to be excluded from the diet. Amount of food to be taken, and the times. Exercise. Sudorifics. Purgatives. Alkalies. Bleeding. Tonics. Vinegar. Diuretics. Iodine. Conclusion.

THE treatment of a disease is most unquestionably the most important part of any discussion concerning it; it is the end of all investigation for us as physicians. We cannot, indeed, be too often reminded, that to us, knowledge, how good and lovely soever it be for its own sake, is still always but a by-end, a step towards that better and lovelier goal, "good will towards men." And while we are reviewing the researches of those whose mission it is to search out pure truth, unless we keep that goal in view, we may boast indeed to be men of science, but we cannot claim that resemblance to the divine nature, which even heathens of old attributed to the scientific healer of diseases.*

But at the same time it is usually the part which is capable of being condensed into the fewest words.

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* Ἰητρος γὰρ φιλσόφος ἰσοθεὸς Hippoc. περὶ εὐσχημοσυνῆς.

"Varietas medicamentorum ignorantiæ filia," and where our treatment is most decidedly useful and effective, there is least to be said about it. Now as I believe the simple remedies which are best to adopt in obesity come under that category, and are thoroughly in accordance with experience and analogy, less time will be spent in enumerating them than on any other part of the subject. The general principles of the management follow, as a matter of course, from the remarks which have preceded on its pathology, but still it may be advantageous to make a few observations on the details of their application.

That form of the disease which commences at birth, and goes on increasing during infancy and childhood, is, I believe, so invariably fatal before the age of puberty, that I do not think we have reason for hoping that it is any way amenable to medicine. At all events, I have not been able to discover any one whose experience has led them to pronounce it curable. It is a form of monstrosity, and as the subjects of it commonly display some other bodily malformation, and a deficiency of intellect, their death is a relief from a miserable prospect.

When it begins in childhood, or about the time of puberty, we must not be deterred, by the circumstance of its being hereditary, from attempting to remedy the inconvenience arising from it. We cannot truly reduce our patients entirely to the average size and weight, but we may enable them to pass life in comfort and usefulness.

The later the disease commences, the more controllable it is by management, until the middle period of life is passed; and then old age impedes in some degree the benefit which we may confer, not by rendering our measures inert, but by preventing our employing them quite so actively as we should have done earlier.

The first thing indicated in all cases is to cut off, as far as possible, the supply of material. Fat, oil, butter, should be rigorously interdicted in the diet table. But all eatables contain some portion of oleaginous matter, and especially those most convenient to advise the use of for a lengthened period. And, as we observed at the former part of our review of the light which chemistry has thrown on the subject, almost all are capable of a transformation into fat, when a small quantity of this substance is previously present. It is desirable, therefore, that the mass of food should lie in the stomach as short a time as possible, in order that at least a fatty fermentation may not be set up in it. Very light meals should be taken at times most favourable to rapid digestion, and should consist of substances easy of solution and assimilation. To this end, the time of the meals should be fixed for an early hour in the day, before exertion has rendered the powers of the entrails languid and weak. Breakfast should consist of dry toast, or, what is still better, sea-biscuit, and if much active exercise is intended, a small piece of lean meat. Dinner at one, on meat with the fat cut off, stale bread or biscuit, and some plain boiled macaroni,* or biscuit pudding by way of second course. We must be careful to explain to our patients, what strangely enough we so often find them ignorant of, that any light dishes we recommend, are not beneficial of themselves, but solely by excluding others more hurtful. I have heard of a dyspeptic gentleman, who having been informed that biscuit pudding was beneficial in his case, said he would never dine without one, but as he usually eat largely before it appeared, the expected advantage did not follow.

Liquids should be taken, not at the meal, but half an hour after, so as not to impede the action of the gastric juice upon the mass. Here should end the solid feeding for the day; no second dinner or supper should follow, nor, indeed, any more meals be taken sitting down. A piece of biscuit and a glass of water can be taken standing up, if faintness is experienced; a cup of gruel or a roast apple before going to bed.

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* I cannot help pausing an instant to speak of the absurdity of our usual way of dressing macaroni. After being boiled and made palatable, it is sprinkled with cheese, and placed before the fire, so as to form a tough, rancid, empyreumatic crust, nauseous and indigestible in the extreme. Boiled till soft, and eaten with French mustard or jam, it makes a soluble and wholesome dish, pleasing to the palate and the reason.

This is not a scale of diet by any means unattainable. A retired butcher and pugilist, whose case I have tabulated (No. 35) has adopted it for some years with the greatest comfort to himself. He is able upon it to work in a most violent manner, in a small garden which he cultivates for himself in the suburbs. He has reduced himself from 20 to 17 stone; whereas his brother, who has not the same strength of mind, has increased to 23 stone in weight. Persons of more refined education ought, and often do, practise the same self-imposed restraint more easily. J. R. (No. 7) has reduced himself from 22 to 18 stone, and sometimes brings himself down to 17, but finds that he derives no particular advantage from being of the lower weight.

The smallest amount of nutriment consistent with the health of the individual can be found by experiment only; but we need not fear that ten ounces of solid food a day is too little, for the last-mentioned gentleman confined himself for a long period to that quantity, and found his mental and bodily powers always equal to the strain which the pursuit of a laborious profession in London demands. It may be remarked, by the way, that it is often advisable to add a small allowance of malt liquor at dinner, as otherwise the craving of the appetite is less easily appeased. The beers to be avoided are of course the thick, sweet kinds, but that which is thoroughly fermented at a low temperature in the Bavarian way, seems to contain very little injurious matter.

I do not know that any advice concerning sleep is peculiarly applicable to obese persons, beyond what we should recommend to all classes of men. A draught of morning dew, " nocturni roris auram ante solis ortum bibendam, " which Aurelian* prescribes for the corpulent, is equally beneficial to every one. They are usually uneasy sleepers, and though lethargic, by no means averse to early rising.

In cases where the fat is largely accumulated in the omentum, it is very convenient for the patient to wear a band round the abdomen, which may be tightened gradually. The support thus given to the abdominal muscles relieves the dragging sensation in the loins, which many persons, whose viscera are heavy in proportion to their strength, experience. It enables exercise to be taken with more facility, and appears also, by pressure, to afford some assistance to the absorption of fat.

The above remarks will apply equally to all forms of obesity; the abstinence recommended can be borne even by the aged, and only comfort be experienced.

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* Morb. Chron. L. v. cap. 4.

As respects exercise, however, a distinction requires to be made. The young and vigorous, whose obesity does not prevent the use of their legs, cannot employ them more usefully than in walking as long as they are able. The greater number of hours per diem that can be devoted to this exercise, the quicker will be the diminution of bulk. But as riding, by the gentle shaking of the abdomen, excites the secretions of the digestive organs more, it should, where practicable, be employed in addition. Where freedom of motion has once been gained, rowing, shooting, any or all of the forms of British gymnastics, should be adopted as regular habits.

But in the asthenic form of the disease, especially in elderly people, this is scarce practicable. The defect in muscular power prevents the use of the limbs in walking for a time long enough to be advantageous. But where riding can be managed, it should on no account be omitted, and the suspensory belt before mentioned is often a valuable auxiliary to the employment of this exercise.

The ancients were much more in the habit than we are of using various forms of friction to the skin in treating chronic complaints; and we find in Aurelian a recommendation to the corpulent to employ dry rubbing, either with cloths alone, or with the addition of various powders. Modern habits of cleanliness supersede, in some degree, these remedies. But the skin is not unfrequently greasy from a thick sebaceous secretion, and the circulation through it languid in asthenic obesity, and in these cases horse-hair gloves may be used with great advantage. Dr. Flemyng strongly advises friction to be employed to the trunk of the body as promoting absorption and invigorating the surface.* The Greek additions of cold bathing or sponging, especially with sea-water, the vapour or hot-air bath, followed by rubbing with salt or with sand, and many other modifications of the same principle enumerated by Aurelian, will naturally suggest themselves to every intelligent patient. A gentleman affected with moderate obesity, whose skin is thick and dark, tells me he derives the utmost physical comfort from the use of the compendious hot-air bath, heated by a spirit-lamp, so much used at our hospitals. He says he can compare the sebaceous secretion which he thus constantly brings out through the skin to nothing but the *vernix caseosa* of a new-born infant. Aurelian also very sensibly advises these remedial measures to be employed fasting, and no food to be taken for some time afterwards; and modern habits render before breakfast a convenient time.

To these rules of management, medicines, strictly so called, must be viewed as secondary and auxiliary.

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* Discourse on Corpulency, p. 15.

Unless these laws are obeyed, whole pharmacopœias are useless.

Purgatives I have generally found not needed in the plethoric form; the bowels usually act once or twice in the day. But in the asthenic obesity of old people, where the abdominal walls are weakened by long pressure of an unnatural weight, it is necessary to employ them. As the habit of taking them will probably be obliged to be continued through life, we must be cautious in the kind employed, and let it be well suited to the individual case.

But there is one class of medicines so universally applicable to all cases of obesity, that I think a trial of them should never be omitted. The chemical affinity of alkalies for fat point them out as appropriate alteratives in this complaint, and experience proves that they are suitable to the state of the digestive organs. The most eligible one is liquor potassæ, as it may be administered in much larger quantities than any other. If given in milk-and-water, we may safely commence with half a drachm, and raise the dose to a drachm, and a drachm and a half, three times a day. The milk covers the taste of the potash better than any other vehicle. It has truly the disadvantage of saponifying a portion of the remedy, but there is no evidence to prove that its efficacy is thereby endangered; indeed, soap itself has been strongly recommended. A physician, whose case is recorded by Dr. Flemyng, (*op. supra cit.,*) reduced himself, by alicant soap alone, two stones in weight.

I have often given the above-mentioned doses of liquor potassæ (even to children in cases of scrofula and consumption) without any harm arising from its use, when taken, as desired, in milk. The fear of alkaline medicines has probably arisen from the injury observed by Huxham* to follow the use of Mrs. Stephen's saponaceous mixture, at one time so popular, and therefore often misapplied. The injury appears to have originated from their being employed in improper cases,—such as debilitated gouty subjects, chronic stone in the bladder, and the like,—to which of course much harm would be done.

In the case of Mrs. S., (No. 6 of the list,) very striking benefit followed rapidly the use of this remedy. She was, as may be seen by her weight, (28 stone 8 pounds,) a woman of extraordinary size, and was becoming, when I first saw her, almost immovable. Her appetite was small, and she drank little, so that not much was to be done in her case by reducing the diet. A very short time after commencing the use of the liquor potassæ, her shortness of breath left her, she was enabled to walk about with comfort; easy sleep at night, such as she had not had for months, returned to her, and the appetite, or, rather, relish, for the small quantity of food allowed her was restored. Instead of being confined to her chair, she has voluntarily come to see me from the extreme east of London several times, and I believe is now continuing to employ the drug from which she has experienced so much relief.

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* Huxham on Fevers, p. 48.

Similar benefit was derived from liquor potassæ in Mrs. Q.'s case, (No. 24,) whose weight was 20 stone, but was "somewhat reduced" by the remedy, as I am informed.

A poor woman, who sold eggs in Chelsea, was becoming quite unable to gain her livelihood by her ordinary occupation. I have not kept a note of her weight and height, and therefore she is not mentioned in the Table of Cases, but she was extremely obese, and the cause of a variety of symptoms she complained of seemed traceable entirely to the accumulation of fat. By taking liquor potassæ only, without change of diet, she was reduced so far as to carry on her trade with comfort.

F. V. (No. 2) and Celia S. (No. 17) are also deriving advantage under the alkaline treatment; but as, in the first case, it was preceded by a bleeding, and, in the latter, is accompanied by a great change of diet, the separate value of the remedy is not so well tested.

Another case was communicated to me the other day of a gentleman who weighed 19 stones 7 lbs. By regimen, exercise, and liquor potassæ, he was reduced two stones and a half in six weeks. At the same time, a fatty tumour with which he was affected was brought under the action of the remedy, and was reduced in size coincidently with the whole body. Perhaps my avocations may prejudice me in favour of medicines in preference to the knife, but I confess that in my own case I should choose this method of removal instead of a surgical operation.

I have mentioned bleeding, and perhaps that may cause some surprise, after the observations which have been made on the state of the circulation in fat people. But where distinct signs of plethora are present—such as pain over the eyebrow, beating of the temples, restless sleep by night, lethargy by day, with full lips and an elastic skin—it is capable of being employed with safety; and where it is employed, the advantages derived at the commencement of a course of treatment is very great, for it gives all the other remedies a fair start; and by affording immediate relief to many symptoms, gives the patient a favourable opinion of the plan he has undertaken. It was of great use to F. V. and J. R. (Cases 2 and 7.)

On the other hand, it is scarcely necessary to say, that much risk attends the loss of blood; for if the heart has become atrophied and weak, it will not stand the shock. Venesection may cause either sudden death from failure of the heart's action, or effusion of blood in the brain from disturbance of the circulation. Let it not be used without the greatest caution.

Bitter tonics are often of great advantage in enabling the stomach to digest more easily and rapidly, and therefore to be contented with a smaller quantity of really nourishing food. The increase of appetite which they cause does no harm; for when patients are getting better, they are usually more obedient to their medical man, and can be taught to control it. Gratitude for the benefit they have received makes them follow advice, however hard.

Some medicines must now be mentioned, which have been recommended for the cure of obesity, but which analogy and experience do not approve.

Vinegar has been employed by those who are foolish enough to practise upon themselves; but as it produces thinness only by injuring the digestive organs, the benefit is not worth the price paid for it, and no medical man would ever advise the use of such a remedy.

Diuretics have been recommended by some of the older authors. I have no experience of their use, and do not see on physiological grounds how they could act beneficially, for there is no secretion by which less carbon in proportion to the amount is removed than that of the kidneys.

Iodine has been spoken of as likely to do good, from the power it exhibits of stimulating the absorbents in cases of scrofula and tumors. But its moderate use certainly does not cause the disappearance of healthy fat. Indeed, it has been noticed by Lugol,* and is matter of daily observation at our metropolitan hospitals, that patients frequently acquire a considerable degree of enbonpoint during the time they are taking iodine. The cases of tumours and of fat are very distinct. As Dr. Pereira remarks, "The enlargements which these agents (mercury and iodine) remove are not mere hypertrophies; their structure is morbid, and they must in consequence have been induced by a change in the quality of the vital activity; in other words, by morbid action. Medicines, therefore, which remove these abnormal conditions, can only do so by restoring healthy action."† But the action which causes the deposition of fat in the adipose tissue is, though excessive, of a healthy nature, and harm, rather than benefit, is to be expected from the medicine under discussion; that harm which always accrues from a valuable remedy wrongly employed. I have heard of one case only where it was taken; and in that instance a wise physician who was called in showed his energetic sense of the folly committed, by putting the bottle into the fire.

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* Essays. Translated by Dr. O'Shaughnessy.

† Pereira's Materia Medica, vol. i. p. 196; edit. 1842.

Of the treatment of fatty tumors I feel I should be stepping out of my place as a physician to speak at length, and therefore the little I had to say I inserted as a kind of appendix to their pathology at the end of the seventh chapter.

The hourly watch over the instinctive desires, which must be observed by one desirous of reducing his corpulence, make it a solemn thing to advise the undertaking of the necessary regimen. He that commences it must be taught to view himself as his worst enemy; like the philosopher in Epictetus, he must "mount guard, and lie in constant ambush against himself."* We must feel very sure that we are doing what is right before we take such a responsibility, otherwise hesitation will produce wavering, and wavering will shake the confidence of the patient, and all hope of benefit be lost. All advantages should be taken of adventitious circumstances to add importance to the enforcement of the rules; they should be written out clear and exact, and enjoined as strictly as if they were moral precepts. If left to general and verbal instructions, their chance of being observed is small indeed.

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* ὡς ἐχθρον ἑαυτον παραφυλάσσει καὶ ἐπιβούλει.—Epicteti Enchiridion, cap. 72.

These are little things, it is true, unless you neglect them.

In all that I have said in the preceding pages I have been anxious to deduce all pathology and treatment from a sound and rational physiology, and have endeavoured to do so in a spirit as undogmatical as possible; not to lay down rules for others, but to tell them what facts and reasonings act as rules in my own mind: "non tam aliis legem pono, quam legem meæ mentis expono, quam qui probat, teneat, cui non placet abjiciat."*

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* Petrarch, De vitâ solitariâ.

CASES OF OBESE PERSONS.

Number and Initials.	*Sex.*	*Age.*	*Height.*	*Weight.*	*Age when Obesity commenced.*	*Attributed Proximate Cause.*	*How far Hereditary.*	*Children, or not.*	*Time of Puberty.*	*Form of Bones.*	*State of Bowels.*	*What Diseases they have had.*
			ft. in.	*st. lbs.*								
1. A. S. M. .	M.	At birth 1 8	. . 2 7 8 7	0 16 2 12 6 3	Birth.	. . . .	Six brothers and sisters not obese.	. . . .	. .	. .	. .	Died at four and a half, of bronchitis.
2. F. V.....	F.	40	5 3	22 0	3	"A fever"	No.	Married; none.	14	Small.	Natural.	Dyspepsia.
3. A. C.....	M.	16	5 7	18 0	5½	Scarlatina.	Collateral.	. . . .	. .	. .	Natural.	
4. M. H. ..	F.	13 25 33	. . 5 2	13 0 15 3 20 5	Childhood.	. . . .	. . . .	. . . .	19	Small.	Natural.	Healthy.
5. E. L.....	F.	26	5 5	14 0	Childhood.	. . . .	On both sides.	Single.	12	Small.	Natural.	Eruptions and varicose veins.
6. Mrs. S...	F.	45 47	5 10	28 8 26 6	8	Scarlatina.	Collateral.	1	9	Small.	Loose.	Dyspepsia.
7. J. R.....	M.	62 66	5 4	23 0 17 0	13	Injury to Spine.	No.	. . . .	13	Small.	Loose.	Swelled feet, oppression from obesity.

CASES OF OBESE PERSONS—*continued.*

Number and Initials.	*Sex.*	*Age.*	*Height.*	*Weight.*	*Age when Obesity commenced.*	*Attributed Proximate Cause.*	*How far Hereditary.*	*Children, or not.*	*Time of Puberty.*	*Form of Bones.*	*State of Bowels.*	*What Diseases they have had.*
			ft. in.	*st. lbs.*								
8. R. A. H.	M.	20	5 5	16 0	14	.. ..	.. ..	.. ..	14	Small.	Natural.	Healthy.
9. Ch. S. ..	F.	26	5 4	16 2	16	.. ..	Collateral.	Single.	15	Small.	Natural.	Healthy.
10. C. H....	M.	..	5 6	26 0	16	Gonorrhœa.	Yes.	.. ..	..	Small.	Natural.	Oppression from obesity.
11. Mrs. L..	F.	23	5 4½	13 0	16 20	? Going to India.	Yes.	Ten miscarriages.	11	Small.	Costive.	
12. D. L.....	F.	21	5 8	16 2	18	.. ..	No.	.. ..	17	Large.	Natural.	Eczema.
13. E. L. A..	M.	30	5 6	17 6 was much more	18	Occupation as cellarman.						
14. S. W. ..	F.	70	5 7	17 0	..	Marriage.	Both sides.	None.	..	..	..	Emphysema of one lung.
15. M. B. ..	F.	36	5 7½	19 7	..	Marriage.	No.	7	..	..	..	Healthy.

16. Mrs. S...	F.	22	5 2	11 0	20	Marriage.	.. ..	Married; none.	14	Small.	Natural.	Plethora.
17. Celia S..	F.	24	4 8	12 0	21	Child-birth.	No.	2	12	Small.	Natural.	Dyspnœa.
18. G.O.B..	M.	40	6 1	19 11	21	Great appetite.	Father.	6	..	Small.	Natural.	1. Dilated heart. 2. Albuminuria. 3. Anasarca.
19. Mrs. W..	F.	28	5 6	15 0	24	Intemperance and erysipelas.	.. ..	.. ..	..	Large.	Costive.	Dyspepsia.
20. H. W. ..	F.	68 dead.	5 7½	18 to 19 0	25	Increased by salivation ten years ago.	Both sides.	4	13	Small.	Costive.	1. Hypertrophied heart. 2. Anasarca. 3. Coma.
21. R. J. G..	M.	25 42	5 10	13 7 19 0	25	"Too little to do."	Yes.	.. ..	..	Moderate.	Natural.	Two fits from plethora, at 30.
22. G. Wn...	M.	50	5 10	19 0	26	Becoming a coachman, from being a postilion.	Mother, and collateral.	.. ..	..	Large.	Natural.	Bronchitis; condensed lung.
23. E. Wg...	F.	58	5 7	16 7	26	Child-birth.	On both sides.	5	..	..	..	Dilated heart; emphysema of lung.

CASES OF OBESE PERSONS—*continued.*

Number and Initials.	*Sex.*	*Age.*	*Height.*	*Weight.*	*Age when Obesity commenced.*	*Attributed Proximate Cause.*	*How far Hereditary.*	*Children, or not.*	*Time of Puberty.*	*Form of Bones.*	*State of Bowels.*	*What Diseases they have had.*
			ft. in.	*st. lbs.*								
24. Mrs. Q..	F.	22 48	5 8½	9 0 20 0	26	An illness.	On both sides.	Two miscarriages.	12	Large	..	Menorrhagia and dyspepsia.
25. W. B. ..	M.	28	5 10	19 0	26	Syphilis; trade of messman.	On both sides.	Single.	..	Small.	Natural.	Healthy.
26. M. H. ..	M.	58 60	5 8	24 0 22 3	26	.. ..	Yes.	15	14	..	Natural.	Chronic rheumatism.
27. T. H.....	M.	56	5 8	19 0	..	.. ..	Yes.	9				
28. S. H.....	F.	55	5 5	15 0	..	.. ..	Yes.	2				
29. M. M. ..	F.	35 38	5 6	20 0 18 0	27	Nursing a sick child.	Father.	3	14	Small.	Natural.	Healthy.
30. Hon.A.P.	M.	35	5 10	16 0	28	Copious weak drinks.	Yes.	Married; none.	..	..	..	Lethargy and dyspepsia.
31. R B.....	M.	38	5 10½	20 1	..	Copious weak drinks.	Collateral.	.. ..	16	Small.	Natural.	Healthy.

32. J. H.....	M.	57 dead.	6 1	36 0	Before 30	Increased enormously at 30, after taking mercury for syphilis.	On both sides.	7	..	..	..	Died of emphysema of lungs and hypertrophied heart.
33. Mrs. A..	F.	52	5 7	19 0	30	Irregular life.	.. ..	12	..	Small.	Natural.	Hernia.
34. J. S.....	M.	33 35	5 3	9 6 14 10	34	Salivation for pneumonia.	No.	Single.				
35. H. T....	M.	58 60	5 10	20 0 17 0	Middle age.	.. ..	Yes.	11	..	Moderate.	Natural.	Cachectic eruption on the legs; partial paralysis.
36. — T.....	M.	58	..	23 0	Middle age.	Excess.	Yes.	?	..	..	..	
37. Mrs. P..	F.	52	5 6	15 7	40	.. ..	On both sides, and collateral.	9	..	Small.	Costive.	
38. A. G.....	M.	63 dead.	5 1	28 0	..	Trade of publican.	A niece very obese.	Several.	..	..	..	Died of "apoplexy of lungs."

APPENDIX.

APPENDIX

ON

EMACIATION.

Anatomical characters of the fat in emaciated persons, as visible to the naked eye and the microscope. Variable emaciation of different parts. Mode in which the fat is disposed of in health, and in disease,—viz. by the lungs. Emaciation, however, not so much due to this drain being increased, as to the supply being diminished. Tubercular cachexia. Consumption without wasting. Hannover's speculations on the loss of fat in Phthisis. Treatment of emaciation.

When, in consequence of some general affection of the system, the fat diminishes in the body, that which remains is considerably altered in appearance and microscopic characters. Instead of being soft and yellowish white in colour, it becomes hard and dark yellow, and will scarcely grease the fingers or knife. When it is examined under a microscope the following appearances present themselves. Instead of cells nearly alike one another, they are seen to be of various descriptions, degrading in fact from the healthy fat cell in different degrees. Some closely resemble the ordinary form of health, in others a moderately large drop of fat occupies the centre, and a small quantity of serum is collected between that and the cell-wall. In others there swims in a great quantity of fluid a ball of fat of a dark yellow colour; in others, again, there are several drops of fat of equal or different size, in variable quantities of liquid. All these cells possess a nucleus, usually of an oval form, and sometimes furnished with a nucleolus. Occasionally it may be seen even without the addition of acetic acid, but comes out much more clearly when this reagent is used. The cell membrane is sometimes so thin that it escapes the eye; sometimes it is thickened, so that a single but thicker darker line appears to the sight, and sometimes even a double line. The size of the cells may be seen to be smaller than that of a healthy one introduced into the field. A number of such cells in close apposition often looks like natural cartilage with adipose cells.

Among the above-mentioned cells which still hold fat, may be found others which are quite emptied of their healthy contents, and are filled with serum only; the wall is sometimes delicate, sometimes thickened; and the nucleus always very easy to see, as soon as it is once brought under the eye.

There are also cells which at first sight appear filled with granular nuclei, but on further investigation these are found to be needle-shaped crystals usually united in the form of a star. These, from the known constituents of human fat, may be assumed to be crystals of margaric acid. And sometimes there is a drop of oil as well as the group of crystals. (See "Histiologische Bemerkungen," by Kölliker, in Kölliker and Siebold's Journal, 1850.)

These appearances may be seen equally in the fat of persons emaciated by phthisis, or any other chronic disease as in those whose fat is removed by dropsy, and replaced by the fluid which fills the areolar tissue.

The fat disappears from different parts of the body with very different degrees of rapidity. The subcutaneous adipose tissue is perhaps the first affected, and the slightest illness will make an alteration in the traits of the countenance, indicating that the fat of the face, which lends so much softness and beauty to the features, has diminished. Later, and from more severe causes, the omentum disappears, and the eyes acquire a hollow look from the soft fat at the back of the orbit having shrunk. The latter, however, seems to be generally very permanent, and, with the fat about the base of the heart, perhaps never entirely disappears. It appears to be so necessary in each situation, that it cannot be spared during the continuance of life.

The anatomical characteristics of emaciation show, then, that the fat is easily removed from the vesicles and replaced by serum, or at least some fluid resembling it.

What becomes of the fat? By what path is it separated from the body, and in what form?

The quantity of carbon which passes away in the breath as carbonic acid is sufficient to account for a very considerable reduction of the carbonized constituents of the body, and it seems not improbable that the fat is made directly serviceable to the keeping up of the animal heat by immediate conversion into gaseous compounds. Such, at least, is the conclusion to which we are led by the following very ingenious suggestions of Dr. G. O. Rees, in the London Edinburgh and Dublin Philosophical Magazine for July 1848. Dr. Rees finds by analysis that the corpuscules of venous blood contain fatty matter in combination with phosphorus; and that this does not exist in arterial blood, except in barely traceable quantities. He suggests, therefore, that the oxygen of the air inspired may unite with these matters, forming water and carbonic acid by combining with the hydrogen and carbon of the fat, and phosphoric acid by combining with the phosphorus. Heat is thus produced, the carbonic acid and the watery vapour are exhaled, and the phosphoric acid, decomposing the soda of the blood from its union with albumen and lactic acid, forms a tribasic phosphate of soda. This latter salt, possessing in a marked degree the property of giving a bright colour to hæmatosin, may be partly the cause of the light crimson tint of arterial, in contradistinction to the lividity of venous blood.

If this rational explanation is the true one, here is a drain constantly at work upon the adipose matter of the body—so long at least as life continues in it; for a loss of power to form animal heat by the conversion of carbon into carbonic acid is synonymous with death. In a state of health, the matter lost is constantly supplied by the food digested; but in most abnormal states the first vital action attacked is assimilation, and thus the supply is cut off while the drain still persists. It is true, it does not persist in full activity in all cases, but still it is sufficient first to exhaust the carbon and then other matters. The simplest example of this is in abstinence, in which state, as appears from the experiments performed by M. Marchand upon frogs, carbonic acid continues to be exhaled though in diminishing amount until death, and that in prolonged abstinence, hydrogen as well as carbon is oxidized in considerable quantities.* In some conditions not only is the supply cut off, but the waste is augmented. Macgregor observed some years ago that in the eruptive stage of small-pox, measles, and scarlet fever, the carbonic acid exhaled by the lungs was, relatively to the whole breath expired, increased in amount; and lately MM. Hervier and St. Sager have found the same in meningitis, peritonitis, and other phlegmasiæ where the respiration is not peculiarly impeded, as it is in inflammations of the thoracic viscera. They have also found it augmented in the hot fit of ague, and in rheumatic fever.* In these cases it would be easy to account for the high temperature which is observed invariably to accompany the disease, by the increased amount of carbon which is converted into a gaseous form; but unfortunately for the simplicity of this explanation, in some patients affected by diseases peculiarly distinguished by the high temperature, the same phenomenon is not observed. Thus, in typhus fevers, MM. Hervier and St. Sager found the exhalation of carbonic acid not only unaugmented but diminished. And in the very different condition of chlorosis, where from the usually cold skin and sluggish vital actions we should on these grounds have anticipated a decrease on the oxidization of carbon, it was on the contrary found by Professor Hannover of Copenhagen to be in absolute amount greater than in a state of health.† Neither does the emaciating power of the disorder afford any measure of the quantity of carbon exhaled, for in pulmonary consumption both authorities agree in finding the quantity very greatly diminished; and not in pulmonary consumption alone, for M. Hervier has remarked that the same is the case in the last periods of cancerous cachexia, scrofula, and syphilis.

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* Journal de Pharmacie et de Chimie, 3me série, T. ix. p. 39.

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* Comptes Rendus de l'Acad. des Sciences, Feb. 19, 1849.

† A. Hannover, De quantitate relativâ et absolutâ acidi carbonici ab homine sano et ægroto exhalati. Hauniæ, 1845. p. 83.

We are justified, I think, on the whole in concluding, that *the increased waste of carbon by the lungs is not in most diseases the cause of emaciation, so much as the inefficient supply arising from defective assimilation*. Loss of adipose tissue accompanies disease of the lungs and consequent disturbance of the functions which excrete carbon, not *necessarily*, or because there exists that derangement of that particular organ, but probably because it usually goes hand in hand with a corresponding derangement of the assimilative viscera, such as the stomach, intestines, liver, abdominal glands, &c. This is the derangement of system which accompanies or precedes in many cases any such deposition of abnormal matter in the lungs, as we are capable of discovering by our modes of measurement or auscultation; a derangement familiar to all of us as "tuberculous cachexia," and which is indicated by the indefinable complaints of the patient long before the physician can point out the lungs or any other single organ as indubitably the cause of the evil.

The symptoms of this state are very various, but all seem to be connected more or less with disorder of the chylopoietic viscera. There is an unaccountable debility and listlessness, showing how the voluntary muscles and nerves are deprived of their usual stimulus. The pulse is weak and small, sometimes slow, showing how the involuntary muscles also suffer. The bowels are variable, sometimes costive, and occasionally excreting soft, fetid, light-coloured fæces, indicating how imperfect has been their action on the food; and at the same time a frequent deposit of white urate of ammonia in the urine tells us the same fact. The glandular structures of the body are liable to congestions, the liver is sluggish, tumid, and painful on pressure, the thyroid and inguinal glands swell, the tonsils are similarly affected and give rise to relaxed sore-throat. The same congestion affects the pelvic viscera, causing hemorrhoids in men and painful menstruation in women. In the present state of our knowledge it seems rational, at least for practical purposes, to look to the chylopoietic mucous tube, and its peculiar circulation the vena portæ, as a proximate cause of these various symptoms.

We are, however, here not so much concerned with the cause of this morbid condition, as with one symptom, the emaciation which always accompanies it. The other symptoms are truly Proteine, and may be present or absent; but this is invariable, and always open to observation by the balance. It thus becomes useful as an indication of the patient's state, whether he is getting worse, or whether our remedies have been successful in staying the progress of the disorder. Indeed, it is the only symptom which is truly useful in that way, for so many circumstances affect the other morbid phænomena, that we can never trust them without the check of some such fact as this increase or decrease of weight.

Now, there are cases of pulmonary consumption where the lungs seem really primarily affected, where we cannot detect any premonitory cachexia, and where the abdominal viscera are healthy. Such occurrences will, I think, explain those anomalous instances of consumption without wasting which may be sometimes observed, where an advanced state of lung disease may exist, and even death happen, with the patient in good condition as far as the adipose tissue is concerned; where not only the traits of feature remain as in health, but the balance shows little deviation from the proper weight.

Loss of weight or emaciation in persons of tubercular habit, I view as an indication of the presence of *tabercular cachexia in an active state;* and where it is not present or has been stayed by treatment, it will, I believe, be found that this disorder of the health is absent or has been cured.

The importance of thus early detecting the existence of tuberculous cachexia, of acting on the indications of the balance without waiting for the stethoscope or spirometer to declare the presence of pulmonary affection, is that at this stage the disease is curable, and its incurable consequences on the lungs and glandular structures capable of prevention.

We are then, I think, acting foolishly to neglect such a simple means of observation as changes in the weight afford us, both for the advantage of each individual patient and for the advancement of science in testing the value of different remedies.

Professor Hannover has some ingenious speculations to account for the departure of the fat from the body in phthisical persons. How, asks he, is the carbon which is brought into the body in the food, conveyed away? Is it excreted in the shape of oil in the liver and carbonized deposits in the lungs? But, supposing such to be the case, this excretion, he says, is not sufficient to make up for the deficiency of the usual outlet by the breath. He therefore suggests that the place of the pulmonary secretion is supplied by an increased quantity of bile, giving rise to diarrhœa, and so to ulceration of the bowels from the augmented acridity and amount of their contents.* We have not, however, any evidence from experience that the quantity of bile is augmented in phthisis, nor that the bilious diarrhœa precedes, and still less that it causes the ulceration of the intestines. And if, as I have suggested, the cause of the emaciation is not the waste of carbon, but deficiency of the usual supply by assimilation, the explanation offered above is superfluous.

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* Hannover, De quantitate acidi carb onici, &c., page 85: Quærendum est quemadmodum carbo, qui corpori alimentis affertur, in phthisicis applicatur, &c. &c.

This is not the place to speak generally of the treatment of pulmonary consumption or tubercular cachexia, except so far as regards that which is especially directed towards the removal of the one symptom we are discussing, and which has induced the mention of them. The emaciation of phthisis is indeed so prominent a part of the disorder, that it is quite natural it should attract the principal attention of patients and of their friends, and that any thing which gives it relief should be looked upon by medical men as a valuable instrument in their hands. And probably with much justice; for though it is impossible to prove directly that life has been prolonged in phthisical cases where an arrest of wasting is produced, yet the universal alleviation of other symptoms which accompanies this arrrest gives a rational hope that such is the result. Any means that can be employed to replace on the body the fat which it has lost, certainly supplies it with a power of resistance to the deleterious influences which are destroying life, and prevents these influences from acting on matters more important than that fat.

Physiology concurs with experience in placing in the first rank of means for restoring fat, animal oils, and especially those derived from the livers of fish. We have here a substance which, as we saw before, nature finds the readiest material for the formation of their proper secretion in the adipose vesicles: and we have it mixed with a small quantity of bile, which preserves it from being made rancid in the stomach, and probably makes it more easy to be taken off by the lacteals. The liver of the cod, being large and abundant, is no doubt the one most used for the purpose of making this oil, and has therefore given its name to the article; but that of many other animals of the same class would probably be equally efficacious. Among the inhabitants of the sea, the dog-fish, otherwise destructive and useless, is employed. Being a few weeks back at Filey in Yorkshire, I found that the herring-fishers not only destroy this wolf of their scaly flocks, but keep his liver to make "Cod-liver Oil." And of fresh-water fish, the salmon. An old Scotch lady tells me that in her youth the Highland women used always to request that the oil which comes to the surface when the fish is boiled, should be preserved for them, as a cure for chronic rheumatism and consumption, the two classes of cases in which the Cod-liver Oil of the present day is most largely employed.

Rare indeed are the opportunities we have of trying any remedy on such a scale as to afford the means of making a statistical deduction concerning its efficacy; and when we have such an opportunity, I think we cannot make too much of it. One has been kindly provided for us by the Governors of the Consumption Hospital at Brompton, in the Report which they have published of the Results of Treatment of the disease for whose relief the establishment was founded. Nothing can be a greater satisfaction than to find one's own experience confirmed by that of a large body united for the purposes of observation, and the records which give the means of such satisfaction cannot be too often laid before us. I shall therefore make no apology for reprinting from this Report the last table (No. XXX.), in which is shown the gain or loss of weight in 219 cases of Consumption treated by Cod-liver Oil, arranged according to the stages of the disease, the ages and sexes of the patients (see next page).

"From this table it appears, that taking both stages of the disease and the sexes collectively, a gain of weight occurred in 70 per cent., a loss of weight in only 21 per cent., and in about 8½ per cent. the weight remained stationary. The amount of the increase varied, being in some patients little more than one or two pounds during several months; whilst, in many, the average increase was from a pound to two pounds weekly during several weeks. Some very remarkable instances of great increase of weight have presented themselves,—

WEIGHT.	First Stage.										Second and Third Stage.										All Stages.	
	Under 15.		15 to 35.		Over 35.		Total.		Per cent.		Under 15.		15 to 35.		Over 35.		Total.		Per cent.		All Ages. Both Sexes.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	Total.	Per ct.
Gained	8	2	50	20	12	3	70	25	78·6	67·5	1	3	22	18	10	4	33	25	61·1	64·1	153	69·8
Lost..	0	0	8	8	0	0	8	8	8·9	21·6	0	0	13	6	6	6	19	12	35·1	30·7	47	21·4
Stationary..	2	1	7	3	2	0	11	4	12·3	10·8	0	0	2	1	0	1	2	2	3·7	5·1	19	8·6
Total..	13		96		17		89	37			4		62		27		54	39			219	

thus, in one instance, 41 pounds were gained in 16 weeks; in another, 19½ pounds were gained in 28 days, and 10 pounds in the succeeding 10 days; in another case, 29 pounds were added to the patient's weight in 31 days. It must be observed, that an amelioration of the symptoms did not invariably follow an increase of weight, though the exceptions were rare. An aggravation of the symptoms and a diminution of weight were almost invariable coincidences. In a few cases the symptoms improved, though the weight remained stationary, or even became slightly diminished. It is right to mention, that in some of the cases marked stationary in the table, the first effects, though encouraging, were not permanent. In other cases, where the amelioriation was still more considerable, and the progress of the disease appeared to have been stayed, relapse occurred, and was followed by a rapid progress to a fatal issue. That such cases do occur requires to be remembered, in order to restrain too sanguine expectations, and to prevent the remedy from falling into the discredit which disappointment after an unlimited confidence may induce. On the other hand, without entering into a description of the successive steps of amelioration experienced by patients (which have been already described under the head of Results of Treatment), it will suffice to say, that many of the cases included in the 18 per cent., in whom the disease is marked Arrested, felt themselves as well as they had been before the attack of the disease. In some of these cases there was, as already stated, a decided and progressive diminution in the local mischief. Comparatively few of such cases having returned to the Hospital after a lengthened interval, it is not too much to assume that the improvement is permanent,—it is so in some cases which are under observation.

"From these facts, and a more extended experience since the period at which this Report terminates, no other conclusion can be drawn than that Cod-liver Oil possesses the property of controlling the symptoms of pulmonary consumption, if not of arresting the disease, to a greater extent than any other agent hitherto tried."*

It would be interesting to know the peculiarities of the several cases alluded to in the report above quoted, where "an amelioration of the symptoms did not follow an increase of weight;" whether or not they are of the class I have before mentioned in which the pulmonary organs appear primarily affected, and where the general powers of assimilation are uninjured. My own individual experience, and that of several others with whom I have conversed, inclines me to believe that such is probably the fact; and that cases of consumption without wasting

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* First Medical Report of the Hospital for Consumption, p. 40.

(*φϑίσις ἄνευ φϑισέως*) are really instances of the disease commencing in the lungs, and abiding in its original seat without affecting the chylopoietic viscera; or where such a state of cachexia has been replaced by the disease of the chest. Here Cod-liver Oil is powerless; it is not a cure for tuberculosis, but a cure for emaciation, and to employ the remedy will, as the Report expresses itself, cause it to fall "into the discredit which disappointment after an unlimited confidence induces."

For emaciation, however, I believe we here possess a remedy such as none other known can take the place of, both as regards the universality of its application, and the small number of the contra-indicating circumstances. And in arresting emaciation we not only remove one of the distressing symptoms of the disorder, but we supply the body with the means of resistance to morbid processes, and we prolong life, if not to the ordinary duration, yet much beyond what its limits would otherwise have been. If this is a cure, consumption, on statistical evidence, is curable; if not, the matter is still undecided.

Too little attention has been paid to the mode of administering the oil. It can hardly be doubted but that substances might be combined with it which would make the assimilation more ready and easy, and probably some hints on this head may be gained from the agriculturist. One of the most important of the experiments which are now trying throughout Europe on the raising of animal food, is on the manner of so supplying oil in the diet as to cause it to be most readily appropriated by the digestive organs. One means is the addition of a certain amount of alcohol. The fattening power of grain is an instance of this, but a more striking one was brought forward at the Thirsk agricultural meeting, in August 1850, by Mr. Outhwaite. That gentleman fed a pig on a pure diet of rum and new milk, and caused it to increase in ten days from 37 stone 10 lbs. to 42 stone 12 lbs., thus adding to its body 72 lbs. of fat; the animal taking about three tumblers of rum per diem, and being in a constant state of intoxication.*

The influence of the spirit is probably due to its action on the nervous powers exerted in digestion, and not to any chemical relations of the fat to it; for the greater part is exhaled unchanged, or else as acetic acid, an intermediate state between alcohol and perfect combustion; or probably as carbonic acid and water.† Besides, the quantity taken is not enough to add appreciably to the amount of carbon in the system. Stimulation by alcohol may be viewed as one of the *accidental circumstances* under which the system is disposed to appropriate oily aliment. It is worthy of remark that a mixture of the alcohol with the food was much more effectual than the administration of it alone; for Mr. Outhwaite's pig, when fed on milk and ale in separate troughs, did not fatten nearly so quick as on milk and rum together.

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* Leeds Intelligencer, Aug. 10, 1850.

† MM. Bouchardat et Sandras, Ann. de Chimie et Phys. xxi. 448.

The experiment was tried for a wager, and is not of course a profitable one; but it may give a useful hint to agriculturists to employ in fattening some cheaper forms of alcohol, and to us to try some modifications of it in medicine in combination with oily remedies. It was probably on this principle that Dr. Bardsley of Manchester used forty years ago to give Cod-liver Oil in warm beer.

As the medicine is one which must be continued for weeks, months, aye years, with occasional intermissions, no means must be neglected to prevent it from causing nausea or disgust. I do not know anything which more effectually accomplishes this object than to take it in Infusion of Orange, and to chew previously to swallowing the draught a piece of orange-peel, and another piece afterwards. This does not prevent the addition of spirit or any other drug which experience may hereafter suggest as useful to assist the action of the oil, or fulfil other indications, nor does it stand in the way of the use of other bitter tonics to improve the appetite.

It may be remarked, that animals who are undergoing the process of fattening will often greedily devour a small quantity of fruit, and their appetite and general health appears improved thereby. So have I found in patients taking Cod-liver Oil a decided improvement in the digestive powers when fresh fruit is eaten; not indeed so much as an article of diet mixed with nitrogenized food, when it is apt to cause dyspepsia, as when taken separately and in the manner of a condiment.

THE END.

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